11TH EURASIAN MULTIDISCIPLINARY FORUM

EMF 2022

CONFERENCE PROCEEDINGS

December 2022 BATUMI, GEORGIA

Table of Contents:

Conference Proceedings

The Relationship Between Financial Development and Economic Growth in Five Fragile Countries

Ecem Turgut, PhD Student
Okyay Ucan, Professor
Nigde Omer Halisdemir University, Department of Economics, Turkey

Submitted: 24 March 2022
Accepted: 28 April 2022
Published: 30 December 2022

Cite As:
Turgut E. & Ucan O. (2022). *The Relationship Between Financial Development and Economic Growth in Five Fragile Countries*. European Scientific Journal, ESJ.

Abstract

This study aimed to analyze the causality relationship between financial development and economic growth by using the data of the five fragile countries for the period 1980 to 2018. In this direction, the cross-section dependency is examined, and it is concluded that the cross-section is independent. Then, by performing the Delta homogeneity test, it is aimed to understand whether other countries are affected at the same level without a change occurring in any of the countries considered, and heterogeneity has been reached. Subsequently, the unit root test determines that the variables are stationary at different levels. Dumitrescu and Hurlin panel causality test is performed to test the causality relationship. As a result of the test, while it is seen that there is not a relationship between economic growth and financial development index, the examination with control variables confirmed that there is a causality relationship between economic growth and financial development. These results showed that the demand-leading hypothesis is valid in the five fragile countries. Finally, to understand the causality relationship more clearly in the study, the Hatemi-J asymmetric causality test was performed, and it is understood that the causality relationship between financial development and economic growth may differ according to country.

Keywords: Financial Development, Economic Growth, Causality Test, Hatemi-J Asymmetric Causality Test, Dumitrescu-Hurlin Panel Causality Test

1. Introduction

One of the issues that have attracted attention lately is financial development's impact on the economic growth process. There is a positive and significant relationship between growth and financial depth, generally expressed as the level of development of financial markets. Therefore, as the development level of the countries increases, it is expected that the financial sectors of the countries will be more developed. Therefore, a financial sector development is expected to positively affect economic growth. As a natural consequence of this, financial development is seen as the main indicator of economic growth (Khan and Senhadji, 2003).

The relationship between financial development and economic growth progresses by mutually supporting each other. In this direction, the supply-leading and demand-leading hypotheses have emerged in the literature. The supply-leading hypothesis suggests a causal relationship between financial development and economic growth. The supply-leading hypothesis argues that creating financial markets and institutions deliberately increases the supply of financial services, thus increasing economic growth (Calderón and Liu, 2002). The demand-leading hypothesis claims that financial development reacts to changes in the real sector. In other words, it is stated that there is a causality relationship between economic growth and financial development. Here, with the increase in real economic growth cases, the demand for financial sector increases, leading to the development of the financial sector. Therefore, financial development responds to an increase in economic growth (Eita and Jordaan, 2007). In addition to these two views, (Apergis, Filippidis, and Economidou, 2007) put forward two different views. The first is the view that economic growth and financial development mutually affect each other. In this view, it is naturally expected that there is a two-way causality between the two variables. The second view is that financial development and economic growth do not affect each other, so there is no causal relationship.

Many factors affect financial development. Progress in human society and continuous improvement in culture, religion, and government policies primarily affect financial instruments in informal capital markets (Ekpo, 2016). Thus, a connection is established with many variables, which are effective in financial development. It also offers many opportunities for new products, services, and innovations in the economy and financial environment (Obeidat, 2016).

After discussing the subject briefly from a theoretical perspective, the studies on this subject are included in the literature, and a general inference has been tried to be made within the scope of the analysis. After that, the empirical application is carried out. Within the scope of the analysis, first cross-section dependency is examined, and then a homogeneity test is performed. After the unit root test is done in line with the results obtained,

Dumitrescu and Hurlin causality test is performed, and the causality relationship between variables is generally tested. Finally, to test the causality relationship in terms of countries, the Hatemi-J asymmetric causality test is performed, and the study is completed.

2. Literature Review

The main goal of the countries is to increase their economic growth and reach a high rate of welfare. For this purpose, it is becoming more and more important to investigate the factors that impact economic growth. Financial development and economic growth have attracted attention in the literature, especially in recent times, and have been among the most frequently researched topics. When the literature on the subject is examined, it has been observed that panel data analyses stand out, especially. However, it is seen as a result of the literature review that there are studies based on a single country sample. When the empirical studies conducted on this subject in the literature are examined, it has been determined that very different results have been reached.

Nyasha and Odhiambo (2019), used the 1980-2012 period data of the United States, the relationship between financial development and economic growth is analyzed using the Autoregressive Distributed Lag (ARDL) method in their study. Bank-based and market-based financial development indexes represent financial development better to understand the depth and width of financial development. In conclusion, it confirmed that financial development positively affects economic growth in the United States on both bases.

Škare, Sınković, and Porada-Rochoń (2019) examined the relationship between finance and economic growth in Poland for the period 1990-to 2018 is examined using the time series method. In the study, unlike other studies, the lending structure of the financial sector is also taken into account. As a result of the empirical analysis, it has been shown that financial development plays a vital role in both economic growth and credit growth.

Bist (2018), the relationship between financial development and economic growth has been handled in 16 low-income countries using data from 1995-to 2014. Long-term panel estimates have shown that financial development has a positive and significant effect on economic growth.

Ono (2017) examined the relationship between financial development and economic growth in Russia with the vector autoregression model. Unlike other studies, the analysis was analyzed separately for the 1999-2008 and 2009-2014 periods. As a result, it is understood that there is a causal relationship between growth in money supply and bank lending in the 1999-2008 period, and the demand-leading hypothesis is confirmed for the period. From 2009 through 2014, it is understood that economic growth caused bank leading, whereas there is no causality from money supply to economic growth.

Samargandi and Ghosh (2015) used data from 52 middle-income countries from 1980-to 2008. It has been stated that there is an inverted U-shaped relationship between financial development and economic growth in the long run in a dynamic heterogeneous environment. In addition, it is noted that the effect of financial development may differ between countries due to the heterogeneous structure.

Allegret and Azzabi (2012) tested the relationship between financial development and long-term growth with dynamic panel data techniques for 112 emerging and developing countries from 1975 to 2007. As a result, it partially supported financial development's role in accelerating the convergence of emerging and developing economies towards the world frontier.

Anwar and Nguyen (2009) examined the interaction of financial development and economic growth by using the 1997-2006 period data in the panel data set covering 61 provinces of Vietnam in their study. As a result, it is understood that financial development contributes to economic growth.

3. Data Set and Methodology

In this study, which aims to analyze the causality relationship between financial development and economic growth, the data of the five fragile countries (Brazil, India, Indonesia, South Africa, Turkey) from 1980 to 2018 are used. The model is created due to the empirical studies in the literature examining the causality between financial development and economic growth. The model created within the scope of the study is given below:

$$Economic\ Growth = f\ (Financial\ Development) \quad (1)$$

In this study, six different variables are used to represent financial development. The first of these variables is the financial development index used to measure financial development, the control. Other variables used to represent financial development are domestic credit to the private sector by banks, M2 money supply, gross fixed capital formation, life expectancy used to represent labor in the financial sector, and trade. Economic growth is characterized by gross domestic product. Explanations of the variables used in the model are given in Table 1.

Table 1: Variables Used in the Model

Variable	Define of Variable	Source
GDP	Economic Growth (% of GDP)	World Bank
FDI	Financial Development Index	IMF
DCPB	Domestic credit to private sector by banks (% of GDP)	World Bank
M2Y	Money Supply (% of GDP)	World Bank
GCF	Gross fixed capital formation (annual % growth)	World Bank
LE	Life Expectancy (Total)	World Bank
TRD	Trade (% of GDP)	World Bank

While the GDP variable used in the model is considered the dependent variable, other variables are used as independent variables in the model. While the financial development index measures financial development, other independent variables are used as control variables in the model.

3.1. Cross-Section Dependency

In the standard panel data model, the equation can be created as follows (Hoyos and Sarafidis, 2006):

$$y_{it} = \alpha_i + \beta'_{x_{it}} + u_{it}, \quad i = 1, \dots, N \;\; t = 1, \dots, T \tag{2}$$

In Equation (2), α_i is the individual parameters that do not change with time. β is the K x 1 vector of the parameters to be estimated. x_{it} represents the regressor vector K x 1. Under the H_0 hypothesis, the u_{it} is assumed to be independent, distributed in the same way between cross-sectional units and throughout periods. From here, the hypothesis is as follows:

$$H_0: \rho_{ij} = \rho_{ji} = cor\left(u_{it}, u_{jt}\right) = 0\,, \;\; i \neq j \tag{3}$$

$$H_1: \rho_{ij} = \rho_{ji} \neq 0, \qquad i \neq j \tag{4}$$

In Equations (3) and (4), ρ_{ij}, the product-moment correlation coefficient is obtained as follows:

$$\rho_{ij} = \rho_{ji} = \frac{\sum_{t=1}^{T} \quad u_{it}u_{jt}}{\left(\sum_{t=1}^{T} \quad u^2{}_{it}\right)^{\frac{1}{2}}\left(\sum_{t=1}^{T} \quad u^2{}_{jt}\right)^{\frac{1}{2}}} \tag{5}$$

Accordingly, Breusch and Pagan (1980) proposed an LM test for fixed N under the $T \rightarrow \infty$ assumption. This is shown below.

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}^2{}_{ij} \quad (6)$$

In Equation (6), $\hat{\rho}_{ij}$ is an example estimate of the binary correlation of residues. At this point, significant dimensional distortions are likely to occur when N> Y. In his study, Peseran (2004) found a deficiency for case where N $\rightarrow \infty$ and proposed an alternative to overcome this deficiency of the LM test. This alternative is shown below.

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \quad (7)$$

Equation (7) has exactly zero for fixed values of T and N under a wide class of panel data models, including heterogeneous dynamic models that are subject to multiple breaks in slope coefficients and error variances. In other words, these tests can deviate when the group means zero, but the individual mean different from zero. Pesaran, Ullah, and Yamagata (2008) proposed a cross-section dependency test in which regressors are strongly exogenous, errors normally are distributed, and more suitable for large panels (Pesaran, 2015). Pesaran, Ullah, and Yamagata (2008) make corrections by adding the variance and mean to prevent the deviation; this test is expressed as an adjusted LM test.

$$LM_{adj.} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\hat{\rho}^2{}_{ij} - \mu_{Tij}}{\upsilon_{Tij}} \sim N(0,1) \quad (8)$$

3.2. Homogeneity Test

The homogeneity test, within the scope of panel data analysis, aims to understand whether other countries are affected at the same level by a change that occurs in any of the countries considered. In this context, the economic structures of countries play an important role. If the countries considered in general differ from each other, the coefficients in the model are expected to be heterogeneous. If the countries' economic structures are similar, the coefficients are expected to be homogeneous (Turgut and Uçan, 2019). Regarding panel data analysis, whether the variables are homogeneous or not should be examined. Whether the variables are homogeneous or not changes the format of the unit root tests to be applied. Mohammad developed Delta test. Pesaran and Yamagata (2008) are primarily used in the study.

The Delta test is calculated in two different ways. These are the standard test ($\tilde{\Delta}$) and the adjusted test ($\tilde{\Delta}_{adj.}$). The standard Delta test is determined as follows (Pesaran and Yamagata, 2008):

$$\tilde{\Delta}= \sqrt{N}\left(\frac{N^{-1}\,\tilde{S}-k}{\sqrt{2k}}\right) \tag{9}$$

The adjusted Delta test is determined as follows:

$$\tilde{\Delta}_{adj}= \sqrt{N}\left(\frac{N^{-1}\,\tilde{S}-E\left(\tilde{Z}_{iT}\right)}{\sqrt{Var\left(\tilde{Z}_{iT}\right)}}\right) \tag{10}$$

3.3. Panel Unit Root Test

Im, Pesaran, and Shin's (2003) panel unit root test is the developed version of the Im, Pesaran, and Shin (1997) test, considering whether the error term is correlated or not, and (T) time series and (N) cross-section data size are finite and infinite. This test is based on the null hypothesis that there is a unit root that assumes that (ρ_i) is equal to 1 for all (i) section data, and it is stated that the random process is valid as follows (Güriş, 2018; Im, Pesaran and Shin, 2003):

$$Y_{it} = \mu_i + \rho_i Y_{i,t-1} + u_{it} \qquad t = 1, \dots T \qquad i = 1, \dots N \tag{11}$$

During the random process, the autoregressive parameter ρ_i is transformed into the model-Dickey-Fuller type equation form due to the downward deviation of small samples.

$$\Delta Y_{it} = (\mu_i - 1) + (\rho_i - 1)Y_{i,t-1} + u_{it} \tag{12}$$

$$\Delta Y_{it} = \alpha_i + \delta_i Y_{i,t-1} + \varepsilon_{it} \tag{13}$$

The basic hypotheses of the test are given below:

$$H_0: \delta_i = 0 \qquad There\ is\ a\ panel\ unit\ root\ for\ the\ entire\ (i) section\ unit \tag{14}$$

$$H_1: \delta_i < 0 \qquad i = 1,2, \dots, N_1 \qquad \delta_i = 0, \qquad i = N_1 + 1, N_1 + 2, \dots, N. \tag{15}$$

is established. This test proposes unit root tests for dynamic heterogeneous panels based on the average of different unit root statistics.

3.4. Panel Causality Test

Causality analysis, first developed by Granger (1969), helps investigate whether variables other than that variable provide useful information in predicting the future value of a variable. The main reason for Granger causality testing within the panel data is to make utilization of the advantages of the panel data models structure. It provides significantly more flexibility in modeling the behavior of cross-sectional units by extending the Granger causality method to be applied to panel data. In addition, panel size allows for analytical analysis of significantly more observations than time series (Hood, Kidd, and Morris, 2006). At this point, one of the most important panels causality tests is the causality test developed by Dumitrescu and Hurlin.

Dumitrescu and Hurlin Panel Causality Test are tested with the alternative hypothesis that there is at least one cross-section relationship against the null hypothesis under the absence of a homogeneous causality relationship. In Dumitrescu and Hurlin causality test, when X and Y express two stationary processes observed during the T period for N number of units, they consider the following linear heterogeneous model for each unit (i) at time t (Bozoklu and Yılancı, 2013):

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \quad (16)$$

In equation (16) $\beta_i = (\beta_i^{(1)}, \beta_i^{(2)}, \beta_i^{(3)}, \dots, \beta_i^{(k)})$. While assuming that (α_i) individual effects are constant, the assumption that $(\gamma_i^{(k)})$ lag parameters and $\left(\beta_i^{(k)}\right)$ regression slope coefficients vary between units is valid. Accordingly, the fixed effects model is established in the causality test. The hypotheses obtained by using Equation (16) are given below.

$$H_0 = \beta_i = 0 \; \forall i = 1, \dots, N \quad (17)$$

$$H_1 = \beta_i = 0 \; \forall i = 1, \dots, N_1$$
$$\beta_i \neq 0 \; \forall i = N_1 + 1, \dots N \quad (18)$$

In equation (18) $0 \leq N_1/N < 1$, the test statistic used to test the basic hypothesis is the simple average of individual Wald statistics.

$$W_{N,T}^{Hnc} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \quad (19)$$

For small values of T, it is suggested to use standardized test statistics since individual Wald statistics do not converge to the same chi-square distribution.

$$\underline{Z}_{N,T}^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - \sum_{i=1}^{N} E(\underline{W}_{i,T})\right]}{\sqrt{\sum_{i=1}^{N} Var(\underline{W}_{i,T})}} \quad (20)$$

In equation (20), the variance and mean T ≥ 6 + 2K are calculated as follows.

$$E(\underline{W}_{i,T}) = N^{-1}\sum_{i=1}^{N} E(W_{i,T}) = Kx\frac{(T-2K-1)}{(T-2K-3)} \quad (21)$$

$$Var(\underline{W}_{i,T}) = N^{-1}\sum_{i=1}^{N} Var(W_{i,T}) = 2Kx\frac{(T-2K-1)^2\ x\ (T-K-3)}{(T-2K-3)^2\ x\ (T-2K-5)} \quad (22)$$

One advantage of the Dumitrescu and Hurlin (2012) causality test is that it can also be applied for unbalanced panels and panels where units have heterogeneous lag lengths. In this case, instead of the equation (20), the following equation should be used.

$$\underline{Z}_{N,T}^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E(\underline{W}_{i,T})\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(\underline{W}_{i,T})}}$$

$$= \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} K_i\ x\ \frac{(T_i-2K_i-1)}{(T_i-2K_i-3)}\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} 2K_i\ x\ \frac{(T_i-2K_i-1)^2 x (T_i-K_i-3)}{(T_i-2K_i-3)^2\ x\ (T_i-2K_i-5)}}} \quad (23)$$

4. Empirical Findings

The most important problem in panel data studies is whether the series contain cross-section dependence. Because, in line with the result obtained here, first or second-generation unit root tests should be applied to the series. However, this part is directly neglected in many studies, thus preventing accurate results. Unlike other studies, the empirical analysis is first started in this study by testing the cross-sectional dependence. The results of the cross-section dependence test results are given in Table 2.

Table 2: Cross Section Dependency Test Results

Test	Statistics	P-value
LM	13.89	0.178
LM adj*	1.905	0.056
LM CD*	1.747	0.080

When looking at the cross-section dependency as a model in Table 2, it is seen that the null hypothesis that there is cross-section independence at the 5% significance level is accepted at the end of all three tests. The absence of cross-section dependence indicates that first-generation unit root tests should be performed on the variables. However, a problem with first-generation unit root tests is the assumptions of heterogeneity and homogeneity. Therefore, before performing the first generation unit root tests, it is necessary to make a homogeneity test and decide which of the first generation unit root tests is suitable for the analysis. The results of the Delta homogeneity test performed within the scope of the study are given in Table 3.

Table 3: Delta Test Results

Test	Delta	p-value
Δ	2.247	0.025
$\Delta_{adj.}$	2.520	0.012

H_0: slope coefficients are homogenous

Delta homogeneity test developed by Pesaran and Yamagata (2008) allows analysis in cases where both N> T and T> N. When Table 3 is examined, it is seen that the null hypothesis is rejected because the probability values are less than 5% significance level. Hence, heterogeneity has been concluded. Therefore, applying a unit root test that accepts the heterogeneity assumption is deemed appropriate. Im, Pesaran, and Shin unit root test results are given in Table 4.

Table 4: Im, Pesaran, and Shin Unit Root Test Results

Variables	Level		First Difference		Result
	Statistics	**Probability**	**Statistics**	**Probability**	
GDP	-5,690	0.000	-	-	I(0)
FDI	-1,682	0.046	-	-	I(0)
DCPB	-0.046	0.481	-6.327	0.000	I(1)
M2Y	-0.730	0.232	-5.619	0.000	I(1)
GCF	-0.607	0.271	-5.073	0.000	I(1)
LE	-5.926	0.000	-	-	I(0)
TRD	-1.655	0.049	-	-	I(0)

When Table 4 is examined, it is seen that the dependent variable GDP and independent variables FDI, LE, and TRD variables are stationary at the

level, while the first difference of DCPB, M2Y, and GCF variables are stationary. Therefore, it is understood that the variables are stationary at different levels.

To apply the Dumitrescu and Hurlin Causality Test to the variables, all variables must be stationary at the level. Therefore, Dumitrescu and Hurlin Causality tests are performed by taking the differences of DCPB, M2Y, and GCF variables which are stationary in the first difference. Dumitrescu and Hurlin Causality Test results applied within the scope of the study are given in Table 5.

Table 5: Dumitrescu and Hurlin Causality Test Results

Null Hypothesis	W-Statistic	Zbar-Statistic	Probability	Result
FDI --/--> GDP	2.314	0.177	0.859	Accept
GDP --/--> FDI	2.323	0.186	0.852	Accept
ΔDCPB --/--> GDP	1.985	-0.148	0.881	Accept
GDP --/--> ΔDCPB	17.859	15.346	0.000	Reject
ΔM2Y --/--> GDP	2.131	-0.006	0.995	Accept
GDP --/--> ΔM2Y	4.942	2.737	0.006	Reject
ΔGCF --/--> GDP	2.036	-0.099	0.920	Accept
GDP --/--> ΔGCF	10.046	7.719	0.000	Reject
LE --/--> GDP	5.283	3.088	0.002	Reject
GDP --/--> LE	0.470	-1.630	0.102	Accept
TRD --/--> GDP	1.465	-0.654	0.512	Accept
GDP --/--> TRD	4.826	2.640	0.008	Reject

As a result of the causality test, it is understood that there is a one-way causality relationship from GDP to ΔDCPB, ΔM2Y, ΔGCF, and TRD, while a one-way causality relationship from LE to GDP is understood. While these results show no relationship between growth and financial development index, the analysis with control variables confirmed a causality relationship between growth and financial development. These results show that the demand-leading hypothesis is valid in the five fragile countries.

Conclusion

The relationship between financial development and economic growth has recently been among the most studied topics, increasing interest in the financial sector. This study examined the causality relationship between financial development and economic growth in a sample of five fragile

countries. The data of the relevant variables and countries for the period 1980-2018 are used in the study. While economic growth is considered as the dependent variable in the study, six different variables are used to represent financial development, which is considered as an independent variable. The financial development index, domestic credit to the private sector by banks, M2 money supply, gross fixed capital formation, life expectancy, and trade.

The most important problem in panel data analysis is whether there is cross-section dependency or not. Because, according to the cross-section dependency situation, the unit root test should be done for the variables. Therefore, the cross cross-section dependency test is first performed in this study and the independence result is reached. This result showed that first-generation unit root tests should be applied to the variables. However, in this case, according to the result obtained by performing the homogeneity test, the most appropriate test should be selected from the first generation unit root tests. Therefore, after the cross-section dependency test is performed, the Delta homogeneity test is performed and the heterogeneity result is obtained. Therefore, Im, Pesaran, and Shin (2003) a unit root test, which accepted the heterogeneity assumption, performed, and it was found that the variables are stationary at different levels. Within the scope of the causality test planned, within the scope of the study, Dumitrescu and Hurlin causality tests are performed first. The causality relationship between the variables is aimed to be seen in general. As a result of the analysis, it is seen that there is no relationship between growth and financial development index. Still, as a result of the examination with control variables, it is understood that there is a causality relationship between growth and financial development. These results show that the demand-leading hypothesis is valid in the five fragile countries. This result is found to be suitable for the study of Ono (2017). In addition, as a result of the Hatemi-J asymmetric causality test, it is understood that the causality relationship between financial development and economic growth may vary by country. Hatemi-J asymmetric causality test results are given in the Appendix. More variables representing financial development can be determined in future studies, and a different econometric method can be examined.

References:

1. Allegret, J. & Azzabi Sana. (2012). Développement financier, croissance de long terme et effets de seuil. *Panoeconomicus, 59*(5), 553-581.
2. Anwar, S. & Nguyen, L. P. (2011). Financial development and economic growth in Vietnam. *Journal of Economics and Finance, 35*(3), 348-360.

3. Apergis, N., Filippidis, I. & Economidou, C. (2007). Financial deepening and economic growth linkages: a panel data analysis. *Review of World Economics, 143*(1), 179-198. DOI: 10.1007/s10290-007-0102-3
4. Bist Jagadish P. (2018). Financial development and economic growth: Evidence from a panel of 16 African and non-African low-income countries. *Cogent Economics & Finance, 6*(1), 1449780, 1-17. DOI: 10.1080/23322039.2018.1449780
5. Bozoklu, Ş. & Yılancı, V. (2013). Finansal Gelişme ve İktisadi Büyüme Arasındaki Nedensellik İlişkisi: Gelişmekte Olan Ekonomiler İçin Analiz. *Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi*, *28*(2), 161-187.
6. Breusch, T. S. & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, *47*(1), 239-253.
7. Calderón, C. & Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics, 72*(1), 321-334.
8. De Hoyos, R. E. & Sarafidis, V. (2006). Testing for cross-sectional dependence in panel-data models. *The Stata Journal, 6*(4), 482-496.
9. Eita, J. H., & Jordaan, A. C. (2007). A causality analysis between financial development and economic growth for Botswana. University of Pretoria Department of Economics Working Paper Series, Working Paper No: 2007-22
10. Ekpo, N. B. (2016). Informal Capital Markets and Integrated Rural Development in Nigeria. *European Scientific Journal*, *12*(22), 305-323. DOI: 10.19044/esj.2016.v12n22p305
11. Güriş, S. (2018). *Uygulamalı Panel Veri Ekonometrisi.* İstanbul: Der Yayınları.
12. Hood, M. V., Kidd, Q. & Morris, I. L. (2006). Two sides of the same coin? Employing Granger causality tests in a panel framework. *Political Analysis*, 16.
13. Im, K. S., Pesaran, M.. H. & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, *115*(1), 53-74.
14. Khan, M. S. & Senhadji, A. S. (2003). Financial development and economic growth: a review and new evidence. *Journal of African Economies, 12*(2), 1-14.
15. Nyasha, S. & Nicholas M. O. (2019). Do financial systems spur economic growth in the USA? An empirical investigation. *Panoeconomicus 66*(2), 165-185.
16. Obeidat, Z. M. (2016). Human capital investment and training in Islamic banking industry in Jordan Jordan Islamic Bank for Finance

and Investment. *European Scientific Journal*, *12*(10), 90-103. DOI: 10.19044/esj.2016.v12n10p90

17. Ono, S. (2017). Financial development and economic growth nexus in Russia. *Russian Journal of Economics*, *3*(3), 321-332.
18. Pesaran, M.. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric Reviews*, *34*(6-10), 1089-1117.
19. Pesaran, M..H. (2004). General diagnostic tests for cross-sectional dependence in panels. *Empirical Economics*, 1-38.
20. Pesaran, M.. H., Ullah, A. & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal*, *11*(1), 105-127.
21. Pesaran, M. H. & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, *142*(1), 50-93.
22. Samargandi, N., Fidrmuc, J. & Ghosh, S. (2015). Is the relationship between financial development and economic growth monotonic? Evidence from a sample of middle-income countries. *World Development*, *68*, 66-81.
23. Škare M., Sınkovıć, D. & Porada-Rochoń, M. (2019). Fınancıal development and economıc growth ın Poland 1990–2018. *Technological and Economic Development of Economy*, *25*(2), 103-133.
24. Turgut, E. and Uçan, O. (2019). Yolsuzluğun vergi oranları ile olan ilişkisinin OECD ülkeleri örnekleminde incelenmesi. *Niğde Ömer Halisdemir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *1*(3), 1-17.

Appendix: Hatemi-J Asymmetric Causality Test

Table 1 Results for panel causality (FD indicator: FDI)

Countries	H_0: from GDP to FDI does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	0.125	0.724	0.790	0.374
India	0.600	0.438	0.255	0.614
Indonesia	11.417	0.010*	0.549	0.459
South Africa	0.025	0.875	1.272	0.259
Turkey	20.562	0.000*	0.293	0.588
Countries	**H_0: from FDI to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	2.334	0.127	0.360	0.548
India	1.044	0.307	0.017	0.897
Indonesia	6.112	0.106	0.319	0.572
South Africa	0.229	0.632	9.663	0.002*
Turkey	2.029	0.363	1.045	0.307

(*) show that it is rejected at the 5% level.

Table 2 Results for panel causality (FD indicator: DCPB)

Countries	H_0: from GDP to DCPB does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	0.000	0.998	1.129	0.288
India	4.746	0.029*	1.210	0.271
Indonesia	0.594	0.441	5.297	0.021*
South Africa	1.764	0.184	7.897	0.048*
Turkey	0.782	0.854	0.137	0.711
Countries	**H_0: from DCPB to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	2.250	0.134	0.002	0.964
India	0.461	0.497	0.626	0.429
Indonesia	0.716	0.397	0.227	0.634
South Africa	0.000	0.985	1.268	0.737
Turkey	6.441	0.092**	0.432	0.511

(*) and (**) respectively show that it is rejected at the 5% and 10% levels.

Table 3 Results for panel causality (FD indicator: M2Y)

Countries	$H_{0:}$ from GDP to M2Y does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	0.089	0.766	1.030	0.310
India	0.665	0.415	0.001	0.974
Indonesia	0.772	0.380	0.171	0.680
South Africa	0.412	0.521	7.245	0.007*
Turkey	11.290	0.001*	0.234	0.628
Countries	**$H_{0:}$ from M2Y to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	1.308	0.253	0.136	0.712
India	0.515	0.473	0.002	0.965
Indonesia	0.004	0.950	0.036	0.850
South Africa	0.449	0.503	1.278	0.258
Turkey	2.502	0.114	13.851	0.000*

(*) show that it is rejected at the 5% level.

Table 4 Results for panel causality (FD indicator: GCF)

Countries	$H_{0:}$ from GDP to GCF does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	0.489	0.783	4.202	0.122
India	0.484	0.487	14.327	0.001*
Indonesia	2.913	0.405	12.327	0.006*
South Africa	2.019	0.155	30.028	0.000*
Turkey	1.335	0.248	3.524	0.060**
Countries	**H0: from GCF to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	2.649	0.266	1.497	0.473
India	0.121	0.728	1.545	0.462
Indonesia	0.530	0.088	6.424	0.093**
South Africa	0.451	0.502	0.194	0.650
Turkey	0.747	0.387	0.146	0.702

(*) and (**) respectively show that it is rejected at the 5% and 10% levels.

Table 5 Results for panel causality (FD indicator: LE)

Countries	H_0: from GDP to LE does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	8.105	0.044*	-	-
India	1.925	0.588	-	-
Indonesia	2.013	0.570	-	-
South Africa	0.379	0.945	-	-
Turkey	7.466	0.058**	-	-
Countries	**H_0: from LE to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	10.256	0.017*	-	-
India	8.661	0.034*	-	-
Indonesia	3.728	0.292	-	-
South Africa	44.960	0.000*	-	-
Turkey	77.912	0.000*	-	-

(*) and (**) respectively show that it is rejected at the 5% and 10% level.

Table 6 Results for panel causality (FD indicator: TRD)

Countries	H_0: from GDP to TRD does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	17.956	0.000*	0.165	0.685
India	6.913	0.009*	0.351	0.554
Indonesia	0.073	0.786	0.001	0.974
South Africa	2.825	0.093**	1.429	0.489
Turkey	2.251	0.134	0.061	0.805
Countries	**H_0: from TRD to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	13.196	0.001*	5.254	0.022*
India	0.731	0.392	0.196	0.658
Indonesia	0.012	0.914	0.000	0.992
South Africa	0.064	0.801	2.100	0.350
Turkey	0.095	0.758	0.005	0.945

(*) and (**) respectively show that it is rejected at the 5% and 10% levels.

Conference Proceedings

Effect of Salt Content on Biogas Production and Microbial Activity: Review Study

Ali Alhraishawi
Department of Civil Engineering,
College of Engineering, Misan University, Iraq
Sukru Aslan
Sivas Cumhuriyet University,
Department of Environmental Engineering, Sivas, Türkiye

Submitted: 28 June 2022
Accepted: 04 October 2022
Published: 30 December 2022

Cite As:
Alhraishawi A. & Aslan S. (2022). *Effect of Salt Content on Biogas Production and Microbial Activity: Review Study*. European Scientific Journal, ESJ.

Abstract

Over the years, biogas production technology has advanced with the goal of reducing process costs and greenhouse gas emissions, and increasing biogas production. Several design factors and operational aspects must be taken into account in order to produce a stable and efficient biogas. When the substrates contain high salts, anaerobic treatment will be ineffective due to the disadvantages of high energy input and operating cost, membrane contamination, and low efficiency. This indicates that the treatment of high salinity organic waste is a big challenge. High salinity levels had a negative effect on bacterial growth through bacterial osmotic pressure metabolism. For example, high salinity can alter the course of fermentation and the accumulation of volatile fatty acids at high concentrations, as well as cause a decrease in methane yield and maximum rate of methane production, prolonging the late-stage period. A low level of salt concentration encourages the growth of bacteria since sodium is essential for the growth and metabolism of microorganisms in AD systems. When the sodium salt concentration is less than 8 g/L, there is no significant inhibition in the generation of methane. Addition of >8 g/L NaCl, however, significantly reduced methane production (causing 17-80 percent inhibition). This paper focuses on understanding in detail how NaCl affects methane production and microbial activity, report salt concentrations that improve process efficiency and reduce inhibition, as well

as review the modified kinetic model and demonstrate the effect of salt on methane production and delay in methanogenesis.

Keywords: Anaerobic digestion, salt content, methane production, microbial

Introduction

Anaerobic Digestion of Organic Wastes

An organic waste (OW) generation has garnered public attention due to its amount, odor, and potential for pathogenic microorganism contamination. This is as a result of the population growth and societal changes. Conventional treatments, such as landfills and incineration, have negative environmental impacts (Cheng et al., 2010). The OW contains a high proportion of organic matter and substantial proportions of carbon and nutrients. In order to produce high-value products by anaerobic fermentation, food waste (FW) and an activated sludge produced through biological treatment are commonly considered as alternative substrates (De Gioanniset al., 2013; Pasupuleti et al., 2014). Furthermore, The OW components can be transformed into long-term products such as volatile fatty acids (VFAs), which can be employed as an alternative carbon source in current wastewater treatment facilities for biological nutrient removal and to produce methane and bio-hydrogen (Ye et al., 2013; Jie et al., 2014). Methane and bio-hydrogen are renewable energy sources that can be used as a substitute for fossil fuels (Lin et al., 2013). Rather than using traditional methods, such as dumping, landfilling, anaerobic composting, or conversion into animal feed, anaerobic digestion of OW has been considered as an effective method to cope with the environmental problem caused by the OW. Anaerobic digestion (AD) has a number of advantages, including high energy recovery with a modest amount of energy input, and the creation of renewable and environmentally friendly gas (CH_4) (Ghosh et al., 1974; Vanstarkenburg, 1997). Throughout the last decade, AD of the organic portion of municipal solid waste (OFMSW) has been widespread in Europe. The following are the primary drivers of this rise: (i) European legislation limiting landfill treatment of biodegradable waste (99/31/EC), (ii) an increase in source-sorted trash collection, and (iii) anaerobic treatment of biodegradable fraction resulting in increased energetic valorization (De Baere, 2006). Sludge is produced as a by-product of the physical, chemical, and biological processes employed in wastewater treatment plants. The AD has proven to be an excellent approach for treating the sludge since it can lower the overall load of biosolids to be disposed by up to 0.590 m^3/kg per kg of volatile solids (VSs) (Appels et al., 2011). It is feasible to generate 20 to near 300 kWh of net energy per tonne of garbage when biogas is used to generate electricity (European Commission, 2005).

Many estimates have indicated that capturing CO_2 and recovering energy from biogas can significantly reduce greenhouse gas (GHG) emissions (Karagiannidis et al., 2009), while also avoiding ozone depletion and acid rain generation (Khalid et al., 2011). Another advantage of using biomass to generate biogas is that the solid waste product of AD (digestate) contains remineralized nitrogen and phosphorus, making it suitable for use as an organic fertilizer (Ward et al., 2008). Several reports indicated that AD of the organic fraction of solid waste produces promising quantities of biogas as indicated in Table 1.

Table 1. Methane production from AD of various substrates

Substrate type	Methane yield	Methane %	Reference
Municipal solid waste	0.36 m^3 CH_4/kg VS	65	(Kwietniewska et al., 2014)
Vegetable waste	0.16 m^3 CH_4/kg VS	68	(Rajeshwari et al., 1998)
Swine manure	0.33 m^3 CH_4/kg VS	-	(Ahn et al., 2009)
Food waste leachate	0.294 m^3 CH_4/kg VS	-	(Behera et al., 2010)
Straw	(0.27–0.29) m^3 CH_4/kg VS	75.9–78	(Lei et al., 2010)
Swine manure with winery wastewater	0.107 m^3 CH_4/kg VS	-	(Riaño et al., 2011)
Jatropha oil seed cake	0.394 m^3 CH_4/kg TS	66.6	(Chandra et al., 2012)
OFMSW with Sewage Sludge	0.242-0.656 m^3 CH_4/kg VS	-	(Corsino et al., 2021)
Corn stover and pig manure	0.275 m^3 CH_4/kg VS	43	(Qiu et al., 2021)

Anaerobic Digestion Process

AD is carried out by a sequence of metabolic events through several kinds of bacteria, including hydrolysis, acidification, acetogenesis, and methanogenesis. The first group of microorganisms hydrolyzes complex chemical substances enzymatically into monomers (e.g., glucose, amino acids), which are then transformed into higher volatile fatty acids (VFA), hydrogen, and acetic acid. The highly volatile fatty acids generated, such as propionic and butyric acid, are then converted to H_2, CO_2, and acetic acid by Acetogens. Thereafter, the H_2, CO_2, and acetate are eventually converted to CH_4 and CO_2 by methanogenic bacteria (Miyamoto et al., 1997; Khalid et al., 2011). The chemical composition of the feedstock/waste, ambient parameters, and digester operation conditions are important because all influence metabolic activity and the bacteria species, which are active during AD (Kiener et al., 1983; Fetzer et al., 1993). The interaction between acetogens and methanogens, on the other hand, is extremely complicated. Since these microbes are anaerobes, oxygen poses a threat by disrupting metabolic pathways, resulting in the oxidation of cellular components that are normally present in reduced form. Several methanogens, on the other hand, have been

shown to adapt to oxygen due to the inclusion of genes that produce enzymes (e.g., catalase and superoxide dismutase) in their genomes, which aid in the defense against oxygen toxicity (Brioukhanov et al., 2006). Methanogens such as *Methanobacterium thermoautotrophicum, Methanobrevibacter arboriphilus, and Methanosarcina barkerii* have been found to be highly resistant to oxygen and dessication (Kiener et al., 1983; Fetzer et al., 1993). Other studies indicated that with the creation of thick outer cell layers made of extracellular polysaccharide (EPS) and the buildup of cyclic 2,3-diphosphoglycerate, *M. barkeri* had an innate ability to withstand extended periods of exposure to air and deadly temperatures after the desiccation process (a novel metabolite which may be used to stabilize proteins at elevated temperatures). Furthermore, glycerol molecules bound by ether bonds to branched isoprene hydrocarbon molecules in the membrane lipids of archael species cause the organisms to acclimate to such severe temperatures. Acidogens, syntrophic acetogens, and methanogens make up the majority of the microbial community in a digester system (Anderson et al., 2012; Manyi-Loh et al., 2013; McInerney et al., 2009). The literature on AD reveals a wide range of inhibition/toxicity levels for most compounds. The intricacy of the AD process, where mechanisms such as antagonism, synergism, acclimation, and complexing could have a considerable impact on the phenomena of inhibition, is the main cause for these variances. In addition, numerous factors must be regulated to avoid difficulties that cause inhibition of biogas production. Microbial activity is directly influenced by temperature, pH, retention time, salinity, and organic loading rate. Furthermore, the physical characteristics of the feedstock can vary, and it may contain hazardous compounds that affect microbial activity (Refai, 2017; Annibaldi et al., 2019). When food is processed, salt (for example, NaCl), a sort of food flavoring ingredient accumulates in food waste in significant levels. The average concentration of NaCl is between 2% and 5% (in terms of mass fraction), and the content might change significantly depending on regional eating customs. Na^+ is a crucial component for anaerobic digestion system's cell creation, development, and metabolism (Zhao et al., 2017). Pang et al. reported in their study that NaCl (sodium chloride) is an inexpensive chemical with a wide range of sources. They also mentioned that the concentration of NaCl with appropriate doses could lead to the dissolution of the sludge and the deterioration of the blocks structure. Extracellular polymeric materials (EPS) release carbohydrates and proteins (Pang et al., 2020). However, high concentration of NaCl can reduce microbial activity and result to negative effects on AD to some extent (Li et al., 2020). Ammonia, heavy metals, fatty and lipid molecules, and excessive salinity are just a few of the components that have been found to hinder the AD process. High salinity, which could severely limit AD, primarily contains cations of Na, K, Ca, Mg, and Fe (Oh et

al., 2013; Chen et al., 2008; Ngan et al., 2020). Also, in the study conducted by Yin et al. (2022), they found that increased salinity could trigger an expensive stress response for bacteria to balance the osmotic pressure in the cellular cytoplasm and reduce the energy available for metabolism. They further mentioned that methananositas, which belong to aceto-clastic methanogens, are subject to salt stress and their relative abundance is low. This is attributed to the inhibition of methane process at salt concentration higher than 25 g-NaCl/L (Yin et al., 2022). Biogas generation from solid OW is often carried out by several different anaerobic bacteria. The acid-forming and methane-forming microorganisms in AD have vastly different physiologies, dietary requirements, growth kinetics, and environmental sensitivity (Pohland et al., 1971). The principal cause of reactor instability is a failure to maintain the equilibrium between these two groups of bacteria. Therefore, this reference study aims to identify three things: to know the effect of high salinity levels on the process of AD and microbial activity, to reveal the effect of inhibition on acidification and methane processes at different salinity levels, and to review the modified kinetic model during anaerobic digestion of salt wastes, respectively.

Effect of Salt Content on Biogas Production

Although the composition of FW varies greatly depending on the source of collection, it usually contains a high level of salinity. The NaCl-added FW had 10 to 35 g/L NaCl, while the non-washed FW included 11.6 g/L NaCl (Shetty et al., 2008). It was reported that the FW from Shanghai cafeterias with an NaCl concentration of 8.0 g/L (Dai et al., 2013). The NaCl concentration in FW anaerobic digestate can reach 13.8 g/L (Wang et al., 2016). This increased salinity could produce an osmotic stress imbalance in cells, leading to plasmolysis and/or cell activity loss, which impedes and perhaps result to failure of the AD process (Lefebvre et al., 2007). According to a previous study, despite its highly nutritious biomass (Nagai et al., 2002), the consumption of FW from soy sauce was problematic due to its high salinity of 10% (w/w). Another study looked at the impact of salinity on biogas generation from food waste leachate and discovered that 0.52 g/L NaCl increased methane yield whereas 5 and 10 g/L NaCl reduced methane yield by 36 and 41 %, respectively (Lee et al., 2009). Rinzema et al. reported that at Na+ concentrations of 5, 10, and 14 g/L, the synthesis of methane from acetate is hindered by 10, 50, and 100%, respectively (Rinzema et al., 1988). Another study found that Na^+ concentration of 2 to 10 g/L inhibited methanogenic activity moderately, while a concentration exceeding 10 g/L inhibited strongly (Gourdon et al., 1989). It was reported that methanogenesis was impaired at an NaCl concentration of 5 g/L, while acidogenesis was significantly damaged (Lefebvre et al., 2007). At Na^+ of 4.42 g/L, the greatest methane output of

290.41 ± 34.21 mL of CH_4/ gVS was obtained. Meanwhile, at a salt content of 4.42 g/L, greater VFA synthesis was found. In the same investigation, inhibitory concentration values of 10%, 50%, and 90% were found at Na^+ concentrations of 6.3, 11.3, and 18.7 g/L respectively (Zhang et al., 2017). Salt is harmful to bacteria and due to osmotic pressure, high quantities of salt concentrations dry the cells (Elefsiniotis et al., 2007; Feijoo et al., 1995). When the sodium content was ≤ 6.0 g/L, VFA production improved because the osmotic pressure was too low to change（Appels et al., 2011; Patel et al., 1997). A previous study found that the level of electrical conductivity (EC) at 35 mS cm^{-1} (19 mg/L NaCl) hindered CH_4 production. The EC level with a greater salt concentration of 80 mS cm^{-1} (44 mg/l NaCl) suppressed not only CH_4 and CO_2 production, but also organic compounds breakdown (Ogata et al., 2016). Increased salt concentration (0, 13, 30, and 60 g NaCl/L) had a negative influence on biogas volume produced from a co-digestion of food waste (Alhraishawi & Alani, 2018). Excessive salinity (NaCl >4.4 g/L) decreased AD performance. Additionally, the high salinity led to decreased microbial Ca^{2+} Mg^{2+} - ATPase activity, subpar EPS secretion, and the greatest variation in microbial operational taxonomic units, which together impeded AD process (Shi et al., 2021).

Effect of Salt Content on Microbial Community

Low salinity concentrations of 350 mg Na^+/L (0.8 g/L NaCl) were advantageous for methanogen growth, while 8-13 g/L NaCl caused significant inhibition and values exceeding 20 g/L NaCl led to severe impairment (Appels et al., 2008; Chen et al., 2008; Omil et al., 1996). It was reported that the specific CO_2 production rate in the high concentration of NaCl (High group) was much higher than in the blank group. Increasing NaCl concentrations up to a certain level had no negative impact on the bacteria's capacity to degrade organic compounds in acidogenesis. However, when the NaCl content reaches 20 g/L, it might increase the acidogenic impact. In contrast to acidogenesis, the specific CH_4 generation rate in methanogenesis showed a considerable suppression when NaCl concentrations were increased from 5 to 20 g/L, resulting in a 37.12 % decrease in the specific CH_4 generation rate (Wang et al., 2017). A previous study by Pang et al. (2022) indicated that the protease activity significantly increased at the NaCl concentrations within the range of 10–30 g/L, while the α-glucosidase activity decreased. It could be inferred that the hydrolysis of proteins improved and the hydrolysis of carbohydrates inhibited in the NaCl helped promote anaerobic fermentation (Pang et al., 2020). Acclimatization to high salt concentrations might result in the succession of halotolerant or even halophilic bacteria, thereby allowing the bioreactor to progressively restore its functionality (Luo et al., 2016). Increased salinity causes a shift in bacterial and hydrogenotrophic methanogen

populations (Sudmalis et al., 2018). When salinity rises from low to high levels, archaea abundance and genes involved in methanogenesis decrease considerably. Similarly, gene abundance in the hydrogenotrophic pathway decreases (Wu et al., 2017). Acetoclastic methanogens, on the other hand, are more resistant to high salinity than hydrogenotrophic methanogens (Wang et al., 2017). The relative abundances of gram-negative *Pseudomonadaceae sp.* decreased, while salt-tolerant *Thermovirgaceae* and gram-positive *Clostridium sp.* increased 26% and 31%, respectively (Sierra et al., 2018). The hydrogenotrophic *Methanobacterium sp*. grew increasingly dominant among archaea. Another study also indicated that at high salinity, the dominance of *Methanobacterium* and *Methanosaeta* was observed. It was revealed that while the *Methanosaeta sp.* were dominant, they did not have a high salt tolerance (Onodera et al., 2017). A previous study conducted by Zhang et al. (2017) indicated that the dominant phyla of bacteria *Bacteroidetes, Firmicutes,* and *Proteobacteria* and the *Methanobacterium, Methanosaeta*, and Methanosarcina genera in archaea were predominant at different salinities. Hydrogenotrophic methanogens such as *Methanobacterium* can tolerate salinity up to 85 g/L, whereas acetoclastic methanogens, *Methanosaeta*, and Methanosarcina were severely inhibited at salinity greater than 65 g/L (Zhang et al., 2017).

Kinetic Equations on the Effect of the Salt Content on Biogas Production

There are several kinetic models that have been applied during the AD process. Among these kinetic models is the modified Gompertz model, which provides information on the lag phase and the maximum rate of specific methane production (Pramanik et al., 2019), as shown in the equations below:

$$M = P.exp\left(exp\left[\frac{R_M.E}{P}(\lambda - t)\right]\right) \quad \textbf{(1)}$$

M = cumulative methane production (ml), R_m = maximum methane production rate (ml/day), P = methane production potential (ml), λ = lag phase (days) and t = time of digestion (days), E: methane production potential (mL) constant (2.7182).

The first-order model showed a better fit than the modified Gompertz. Nonetheless, when a lag phase was reported, the modified Gompertz model better predicted the BMP compared to the first order (Strömberg et al., 2015). From the original form, the modified Gompertz equation is established as shown in equation (2):

$$M = P.exp\left(\left[\frac{-r_0}{\alpha}.exp(-\alpha.t)\right]\right) \quad \textbf{(2)}$$

where r_0 and ⟨ are parameters in Gompertz which is directly related to R_m and λ in Eq. (1) (Jijai et al., 2017). According to the study by Anwar et al. (2016), the modified Gompertz model predicted cumulative methane yield

(CMY) accurately ($R^2 > 0.99$) under low salt concentrations. When the sodium salt concentration was increased, the lag period showed a relative increase, with λ being around 5 days for 2-8 g/L. However, it extended with higher sodium salt concentrations. λ was about 19.2 days for the reactor (with the addition of 16 g/L NaCl). Conversely, the methane production potential at 16 g/L decreased from 591 to 212 mL/g VS added, while the maximum methane production rate decreased from 39.4 mL/g VS added to 3.9 mL/g VS added (Anwar et al., 2016). In another study, the results showed that adding salt 2-4 g/L, which is the appropriate salt addition according to the results of the modified Gompertz model, could accelerate biogas production and improve the maximum biogas production rate (R_{max}). The delay periods were also very low with the exception of high doses of salt. More so, the researchers proved that the interaction of salt concentration and fermentation was significant for FW characterized by carbohydrates and protein ($p < 0.05$). High salt concentration and fermentation could break the AD system when the feed material is FW marked with carbohydrate. On the other hand, for FW marked with protein, the interaction of fermentation concentrations and addition of salt could mitigate the degrees of inhibition (Li et al., 2019). In another study, it was also shown that adding 4g/L of salt had a positive effect on gas production since the kinetic parameters obtained from the modified Gompertz equation were: P = 328.8 ml CH_4/gVS, R_{max} = 13.15 ml CH_4/(gVS.day), and λ = 2.1 day. A short lag phase of 2.1 day was observed for methane production. A sharp increase in methane production was observed from 2.1 to 6 days and methane production gradually increased (Han et al., 2012).

Conclusion

AD is a waste treatment technique that uses natural anaerobic decomposition to minimize waste volume while also producing biogas. For a long time, it has been used to treat waste from agricultural and industrial processes. The waste stream may contain inhibitory or even hazardous elements, such as salt content, depending on the source. Reduced biogas output and/or methane concentration in the biogas, as well as the possibility of reactor failure, could result from the accumulation of these compounds. The results of earlier investigations on the inhibition of anaerobic processes vary significantly due to differences in anaerobic microorganisms, waste composition, experimental methodologies, and circumstances. Obtaining information on waste components is critical for AD to work properly. It has been discovered that the right amount of salt can boost microbial activity and nutrient release, thereby increasing biogas generation. To avoid severe methane inhibition and poor decomposition performance, it is recommended that the sodium salt concentration in AD be kept below 8 g/L.

References:

1. Ahn, H. K., Smith, M. C., Kondrad, S. L., & White, J. W. (2010). Evaluation of biogas production potential by dry anaerobic digestion of switchgrass–animal manure mixtures. *Applied biochemistry and biotechnology*, *160*(4), 965-975. https://doi.org/10.1007/s12010-009-8624-x.
2. Alhraishawi, A. A., & Alani, W. K. (2018, May). The co-fermentation of organic substrates: A review performance of biogas production under different salt content. In *Journal of Physics: Conference Series* (Vol. 1032, No. 1, p. 012041). IOP Publishing. http://dx.doi.org/10.1088/1742-6596/1032/1/012041.
3. Anderson, K. L., Apolinario, E. E., & Sowers, K. R. (2012). Desiccation as a long-term survival mechanism for the archaeon Methanosarcina barkeri. *Applied and environmental microbiology*, *78*(5), 1473-1479. https://doi.org/10.1128/AEM.06964-11.
4. Annibaldi, V., Cucchiella, F., Gastaldi, M., Rotilio, M., & Stornelli, V. (2019). Sustainability of Biogas Based Projects: Technical and Economic Analysis. In *E3S Web of Conferences* (Vol. 93, p. 03001). EDP Sciences. https://doi.org/10.1051/e3sconf/20199303001.
5. Anwar, N., Wang, W., Zhang, J., Li, Y., Chen, C., Liu, G., & Zhang, R. (2016). Effect of sodium salt on anaerobic digestion of kitchen waste. *Water Science and Technology*, *73*(8), 1865-1871. https://doi.org/10.2166/wst.2016.035.
6. Appels, L., Baevens, J., Degrève, J., & Dewil, R. (2008). Principios y potencial de la digestión anaerobia de lodos activados por residuos. *Prog. Combustible de energía. Sci*, *34*, 755-781. https://doi.org/10.1016/j.pecs.2008.06.002.
7. Appels, L., Lauwers, J., Degrève, J., Helsen, L., Lievens, B., Willems, K., ... & Dewil, R. (2011). Anaerobic digestion in global bio-energy production: potential and research challenges. *Renewable and Sustainable Energy Reviews*, *15*(9), 4295-4301. https://doi.org/10.1016/j.rser.2011.07.121.
8. Behera, S. K., Park, J. M., Kim, K. H., & Park, H. S. (2010). Methane production from food waste leachate in laboratory-scale simulated landfill. *Waste management*, *30*(8-9), 1502-1508. https://doi.org/10.1016/j.wasman.2010.02.028.
9. Brioukhanov, A. L., Netrusov, A. I., & Eggen, R. I. (2006). The catalase and superoxide dismutase genes are transcriptionally up-regulated upon oxidative stress in the strictly anaerobic archaeon Methanosarcina barkeri. *Microbiology*, *152*(6), 1671-1677. https://doi.org/10.1099/mic.0.28542-0.

10. Chandra, R., Vijay, V. K., Subbarao, P. M. V., & Khura, T. K. (2012). Production of methane from anaerobic digestion of jatropha and pongamia oil cakes. *Applied Energy*, *93*, 148-159. https://doi.org/10.1016/j.apenergy.2010.10.049
11. Chen, Y., Cheng, J. J., & Creamer, K. S. (2008). Inhibition of anaerobic digestion process: a review. *Bioresource technology*, *99*(10), 4044-4064. https://doi.org/10.1016/j.biortech.2007.01.057.
12. Cheng, H., & Hu, Y. (2010). Municipal solid waste (MSW) as a renewable source of energy: Current and future practices in China. *Bioresource technology*, *101*(11), 3816-3824. https://doi.org/10.1016/j.biortech.2010.01.040.
13. Corsino, S. F., Torregrossa, M., & Viviani, G. (2021). Biomethane Production from Anaerobic Co-Digestion of Selected Organic Fraction of Municipal Solid Waste (OFMSW) with Sewage Sludge: Effect of the Inoculum to Substrate Ratio (ISR) and Mixture Composition on Process Performances. *International Journal of Environmental Research and Public Health*, *18*(24), 13048. https://doi.org/10.3390/ijerph182413048
14. Dai, X., Duan, N., Dong, B., & Dai, L. (2013). High-solids anaerobic co-digestion of sewage sludge and food waste in comparison with mono digestions: Stability and performance. *Waste Management*, *33*(2), 308-316. https://doi.org/10.1016/j.wasman.2012.10.018.
15. De Baere, L. (2006). Will anaerobic digestion of solid waste survive in the future? *Water science and technology*, *53*(8), 187-194. https://doi.org/10.2166/wst.2006.249.
16. De Gioannis, G., Muntoni, A., Polettini, A., & Pomi, R. (2013). A review of dark fermentative hydrogen production from biodegradable municipal waste fractions. *Waste Management*, *33*(6), 1345-1361. https://doi.org/10.1016/j.wasman.2013.02.019.
17. Elefsiniotis, P., & Wareham, D. G. (2007). Utilization patterns of volatile fatty acids in the denitrification reaction. *Enzyme and Microbial Technology*, *41*(1-2), 92-97. https://doi.org/10.1016/j.enzmictec.2006.12.006.
18. European Commission (2005). Reference document on best available techniques for the waste treatments industries. Integrated pollution prevention and control.
19. Feijoo, G., Soto, M., Mendez, R., & Lema, J. M. (1995). Sodium inhibition in the anaerobic digestion process: antagonism and adaptation phenomena. *Enzyme and Microbial Technology*, *17*(2), 180-188. https://doi.org/10.1016/0141-0229(94)00011-F.

20. Fetzer, S., Bak, F., & Conrad, R. (1993). Sensitivity of methanogenic bacteria to oxygen and desiccation from paddy soil. *FEMS Microbiol*, *12*, 107-115.
21. Ghosh, S., & Pohland, F. G. (1974). Kinetics of substrate assimilation and product formation in anaerobic digestion. Journal (Water Pollution Control Federation), 748-759. https://www.jstor.org/stable/25038188.
22. Gourdon, R., Comel, C., Vermande, P., & Veron, J. (1989). Fractionation of the organic matter of a landfill leachate before and after aerobic or anaerobic biological treatment. *Water Research*, *23*(2), 167-173. https://doi.org/10.1016/0043-1354(89)90040-7.
23. Han, M. J., Behera, S. K., & Park, H. S. (2012). Anaerobic co-digestion of food waste leachate and piggery wastewater for methane production: statistical optimization of key process parameters. *Journal of Chemical Technology & Biotechnology*, *87*(11), 1541-1550. https://doi.org/10.1002/jctb.3786
24. Jie, W., Peng, Y., Ren, N., & Li, B. (2014). Volatile fatty acids (VFAs) accumulation and microbial community structure of excess sludge (ES) at different pHs. *Bioresource technology*, *152*, 124-129. https://doi.org/10.1016/j.biortech.2013.11.011.
25. Jijai, S., & Siripatana, C. (2017). Kinetic model of biogas production from co-digestion of Thai rice noodle wastewater (Khanomjeen) with chicken manure. *Energy Procedia*, *138*, 386-392. https://doi.org/1088/1755-1315/463/1/012008.
26. Karagiannidis, A., & Perkoulidis, G. (2009). A multi-criteria ranking of different technologies for the anaerobic digestion for energy recovery of the organic fraction of municipal solid wastes. *Bioresource technology*, *100*(8), 2355-2360. https://doi.org/10.1016/j.biortech.2008.11.033.
27. Khalid, A., Arshad, M., Anjum, M., Mahmood, T., & Dawson, L. (2011). The anaerobic digestion of solid organic waste. *Waste management*, *31*(8), 1737-1744. https://doi.org/10.1016/j.wasman.2011.03.021.
28. Kiener, A., & Leisinger, T. (1983). Oxygen sensitivity of methanogenic bacteria. *Systematic and Applied Microbiology*, *4*(3), 305-312. https://doi.org/10.1016/S0723-2020(83)80017-4.
29. Kwietniewska, E., & Tys, J. (2014). Process characteristics, inhibition factors and methane yields of anaerobic digestion process, with particular focus on microalgal biomass fermentation. *Renewable and Sustainable Energy Reviews*, *34*, 491-500. https://doi.org/10.1016/j.rser.2014.03.041.
30. Lee, D. H., Behera, S. K., Kim, J. W., & Park, H. S. (2009). Methane production potential of leachate generated from Korean food waste

recycling facilities: a lab-scale study. *Waste Management*, *29*(2), 876-882. https://doi.org/10.1016/j.wasman.2008.06.033.

31. Lefebvre, O., Quentin, S., Torrijos, M., Godon, J. J., Delgenes, J. P., & Moletta, R. (2007). Impact of increasing NaCl concentrations on the performance and community composition of two anaerobic reactors. *Applied microbiology and biotechnology*, *75*(1), 61-69. https://doi.org/10.1007/s00253-006-0799-2.
32. Lei, Z., Chen, J., Zhang, Z., & Sugiura, N. (2010). Methane production from rice straw with acclimated anaerobic sludge: effect of phosphate supplementation. *Bioresource technology*, *101*(12), 4343-4348. https://doi.org/10.1016/j.biortech.2010.01.083.
33. Li, X., Huang, J., Liu, Y., Huang, T., Maurer, C., & Kranert, M. (2019). Effects of salt on anaerobic digestion of food waste with different component characteristics and fermentation concentrations. *Energies*, *12*(18), 3571. https://doi.org/10.3390/en12183571.
34. Li, X. F., Hu, T. N., Huang, J. J., Liu, Y. Y., Peng, D. P., Wu, Z., & Huang, T. (2021, March). Study of salt effect on semi-continuous anaerobic digestion of food waste with modified first-order model. In *IOP Conference Series: Earth and Environmental Science* (Vol. 701, No. 1, p. 012032). IOP Publishing. https://doi.org/10.1088/1755-1315/701/1/012032.
35. Lin, C. S. K., Pfaltzgraff, L. A., Herrero-Davila, L., Mubofu, E. B., Abderrahim, S., Clark, J. H., ... & Luque, R. (2013). Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective. *Energy & Environmental Science*, *6*(2), 426-464. https://doi.org/10.1039/C2EE23440H.
36. Luo, W., Phan, H. V., Hai, F. I., Price, W. E., Guo, W., Ngo, H. H., Yamamato, K., & Nghiem, L. D. (2016). Effects of salinity build-up on the performance and bacterial community structure of a membrane bioreactor. *Bioresource technology*, *200*, 305-310. https://doi.org/10.1016/j.biortech.2015.10.043
37. Manyi-Loh, C. E., Mamphweli, S. N., Meyer, E. L., Okoh, A. I., Makaka, G., & Simon, M. (2013). Microbial anaerobic digestion (bio-digesters) as an approach to the decontamination of animal wastes in pollution control and the generation of renewable energy. *International journal of environmental research and public health*, *10*(9), 4390-4417. https://doi.org/10.3390/ijerph10094390.
38. McInerney, M. J., Sieber, J. R., & Gunsalus, R. P. (2009). Syntrophy in anaerobic global carbon cycles. *Current opinion in biotechnology*, *20*(6), 623-632. https://doi.org/10.1016/j.copbio.2009.10.001.

39. Miyamoto, K. (Ed.). (1997). *Renewable biological systems for alternative sustainable energy production* (No. 128). Food & Agriculture Org. *FAO Agricultural Services Bulletin (FAO)*
40. Nagai, H., Kobayashi, M., Tsuji, Y., Nakashimada, Y., Kakizono, T., & Nishio, N. (2002). Biological and chemical treatment of solid waste from soy sauce manufacture. *Water Science and Technology*, *45*(12), 335-338. https://doi.org/10.2166/wst.2002.0443.
41. Ogata, Y., Ishigaki, T., Nakagawa, M., & Yamada, M. (2016). Effect of increasing salinity on biogas production in waste landfills with leachate recirculation: a lab-scale model study. *Biotechnology Reports*, *10*, 111-116. http://dx.doi.org/10.1016/j.btre.2016.04.004.
42. Oh, S. T., & Martin, A. D. (2013). A thermodynamic equilibrium consideration of the effect of sodium ion in acetoclastic methanogenesis. *Journal of Chemical Technology & Biotechnology*, *88*(5), 834-844. https://doi.org/10.1002/jctb.3909.
43. Omil, F., Mendez, R., & Lema, J. M. (1996). Anaerobic treatment of seafood processing waste waters in an industrial anaerobic pilot plant. *Water Sa*, *22*(2), 173-181.
44. Onodera, T., Syutsubo, K., Hatamoto, M., Nakahara, N., & Yamaguchi, T. (2017). Evaluation of cation inhibition and adaptation based on microbial activity and community structure in anaerobic wastewater treatment under elevated saline concentration. *Chemical Engineering Journal*, *325*, 442-448. https://doi.org/10.1016/j.cej.2017.05.081.
45. Pang, H., Xin, X., He, J., Cui, B., Guo, D., Liu, S., ... & Nan, J. (2020). Effect of NaCl concentration on microbiological properties in NaCl assistant anaerobic fermentation: hydrolase activity and microbial community distribution. *Frontiers in Microbiology*, 2449. https://doi.org/10.3389/fmicb.2020.589222.
46. Pasupuleti, S. B., Sarkar, O., & Mohan, S. V. (2014). Upscaling of biohydrogen production process in semi-pilot scale biofilm reactor: evaluation with food waste at variable organic loads. *International journal of hydrogen energy*, *39*(14), 7587-7596. http://dx.doi.org/10.1016/j.ijhydene.2014.02.034.
47. Patel, G. B., & Roth, L. A. (1977). Effect of sodium chloride on growth and methane production of methanogens. *Canadian journal of microbiology*, *23*(7), 893-897. https://doi.org/10.1139/m77-131.
48. Pohland, F.G., & Ghosh, S. (1971). Developments in anaerobic stabilization of organic wastes – the two-phase concept. Environ. Lett. 1, 255–266. https://doi.org/10.1080/00139307109434990.

49. Pramanik, S. K., Suja, F. B., Porhemmat, M., & Pramanik, B. K. (2019). Performance and kinetic model of a single-stage anaerobic digestion system operated at different successive operating stages for the treatment of food waste. *Processes*, *7*(9), 600. https://doi.org/10.3390/pr7090600.
50. Qiu, Y., Li, C., Liu, C., & Hagos, K. (2021). Co-digestion biomethane production and the effect of nanoparticle: kinetics modeling and microcalorimetry studies. *Applied Biochemistry and Biotechnology*, *193*(2), 479-491. https://doi.org/10.1007/s12010-020-03436-1.
51. Rajeshwari, K. V., Pant, D. C., Lata, K., & Kishore, V. V. (1998, December). Studies on biomethanation of vegetable market waste. In *Biogas forum*.
52. Refai, S. (2017). Development of efficient tools for monitoring and improvement of biogas production. Dissertation zur Erlangung des Doktorgrades, Mathematisch-Naturwissenschaftlichen Fakultätder Rheinischen Friedrich-Wilhelms-Universität Bonn, 131p, https://nbn-resolving.org/urn:nbn:de:hbz:5n-46174.
53. Riaño, B., Molinuevo, B., & García-González, M. C. (2011). Potential for methane production from anaerobic co-digestion of swine manure with winery wastewater. *Bioresource technology*, *102*(5), 4131-4136. https://doi.org/10.1016/j.biortech.2010.12.077.
54. Rinzema, A., van Lier, J., & Lettinga, G. (1988). Sodium inhibition of acetoclastic methanogens in granular sludge from a UASB reactor. *Enzyme and Microbial Technology*, *10*(1), 24-32. https://doi.org/10.1016/0141-0229(88)90094-4.
55. Shi, Y., Fang, H., Li, Y. Y., Wu, H., Liu, R., & Niu, Q. (2021). Single and simultaneous effects of naphthalene and salinity on anaerobic digestion: Response surface methodology, microbial community analysis and potential functions prediction. *Environmental Pollution*, *291*, 118188. https://doi.org/10.1016/j.envpol.2021.118188.
56. Shetty, K. V., Nandennavar, S., & Srinikethan, G. (2008). Artificial neural networks model for the prediction of steady state phenol biodegradation in a pulsed plate bioreactor. *Journal of Chemical Technology & Biotechnology: International Research in Process, Environmental & Clean Technology*, *83*(9), 1181-1189. https://doi.org/10.1002/jctb.1892.
57. Sierra, J. D. M., Oosterkamp, M. J., Wang, W., Spanjers, H., & van Lier, J. B. (2018). Impact of long-term salinity exposure in anaerobic membrane bioreactors treating phenolic wastewater: performance

robustness and endured microbial community. *Water research*, *141*, 172-184. https://doi.org/10.1016/j.watres.2018.05.006.

58. Strömberg, S., Nistor, M., & Liu, J. (2015). Early prediction of Biochemical Methane Potential through statistical and kinetic modelling of initial gas production. *Bioresource Technology*, *176*, 233-241. https://doi.org/10.1016/j.biortech.2014.11.033.
59. Sudmalis, D., Gagliano, M. C., Pei, R., Grolle, K., Plugge, C. M., Rijnaarts, H. H. M., & Temmink, H. (2018). Fast anaerobic sludge granulation at elevated salinity. *Water research*, *128*, 293-303. https://doi.org/10.1016/j.watres.2017.10.038.
60. Vanstarkenburg, W. (1997). Anaerobic treatment of wastewater: state of the art. *Microbiology*, *66*(5), 588-596.
61. Wang, S., Hou, X., & Su, H. (2017). Exploration of the relationship between biogas production and microbial community under high salinity conditions. *Scientific reports*, *7*(1), 1-10. https://doi.org/10.1038/s41598-017-01298-y.
62. Wang, S., Peng, L., Jiang, Y., Gikas, P., Zhu, B., & Su, H. (2016). Evaluation of a novel split-feeding anaerobic/oxic baffled reactor (A/OBR) for foodwaste anaerobic digestate: performance, modeling and bacterial community. *Scientific reports*, *6*(1), 1-14. https://doi.org/10.1038/srep34640.
63. Ward, A. J., Hobbs, P. J., Holliman, P. J., & Jones, D. L. (2008). Optimisation of the anaerobic digestion of agricultural resources. *Bioresource technology*, *99*(17), 7928-7940. https://doi.org/10.1016/j.biortech.2008.02.044.
64. Wu, Y., Wang, X., Tay, M. Q. X., Oh, S., Yang, L., Tang, C., & Cao, B. (2017). Metagenomic insights into the influence of salinity and cytostatic drugs on the composition and functional genes of microbial community in forward osmosis anaerobic membrane bioreactors. *Chemical Engineering Journal*, *326*, 462-469. https://doi.org/10.1016/j.cej.2017.05.172.
65. Ye, J., Li, D., Sun, Y., Wang, G., Yuan, Z., Zhen, F., & Wang, Y. (2013). Improved biogas production from rice straw by co-digestion with kitchen waste and pig manure. *Waste management*, *33*(12), 2653-2658. https://doi.org/10.1016/j.wasman.2013.05.014.
66. Yin, Y., Zhang, Z., Yang, K., Gu, P., Liu, S., Jia, Y., & Miao, H. F. (2022). Deeper Insight into the Effect of Salinity on the Relationship of Enzymatic Activity, Microbial Community and Key Metabolic Pathway During the Anaerobic Digestion of High Strength Organic Wastewater. Microbial Community and Key Metabolic Pathway During the Anaerobic Digestion of High Strength Organic Wastewater. https://doi.org/10.2139/ssrn.4194762.

67. Zhang, H., Jiang, J., Li, M., Yan, F., Gong, C., & Wang, Q. (2016). Biological nitrate removal using a food waste-derived carbon source in synthetic wastewater and real sewage. *Journal of environmental management*, *166*, 407-413. DOI: http://dx.doi.org/10.1016/j.jenvman.2015.10.037.
68. Zhang, Y., Alam, M. A., Kong, X., Wang, Z., Li, L., Sun, Y., & Yuan, Z. (2017). Effect of salinity on the microbial community and performance on anaerobic digestion of marine macroalgae. *Journal of Chemical Technology & Biotechnology*, *92*(9), 2392-2399. https://doi.org/10.1002/jctb.5246.
69. Zhang, Y., Li, L., Kong, X., Zhen, F., Wang, Z., Sun, Y., ... & Lv, P. (2017). Inhibition effect of sodium concentrations on the anaerobic digestion performance of Sargassum species. *Energy & Fuels*, *31*(7), 7101-7109. https://doi.org/10.1021/acs.energyfuels.7b00557.
70. Zhao, J., Liu, Y., Wang, D., Chen, F., Li, X., Zeng, G., & Yang, Q. (2017). Potential impact of salinity on methane production from food waste anaerobic digestion. Waste Management, 67, 308-314. https://doi.org/10.1016/j.wasman.2017.05.016.

Appendix

Table 5 Results for panel causality (FD indicator: LE)

Countries	H_0: from GDP to LE does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	8.105	0.044*	-	-
India	1.925	0.588	-	-
Indonesia	2.013	0.570	-	-
South Africa	0.379	0.945	-	-
Turkey	7.466	0.058**	-	-
Countries	**H_0: from LE to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	10.256	0.017*	-	-
India	8.661	0.034*	-	-
Indonesia	3.728	0.292	-	-
South Africa	44.960	0.000*	-	-
Turkey	77.912	0.000*	-	-

(*) and (**) respectively show that it is rejected at the 5% and 10% level.

Table 6 Results for panel causality (FD indicator: TRD)

Countries	H_0: from GDP to TRD does not causality			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	17.956	0.000*	0.165	0.685
India	6.913	0.009*	0.351	0.554
Indonesia	0.073	0.786	0.001	0.974
South Africa	2.825	0.093**	1.429	0.489
Turkey	2.251	0.134	0.061	0.805
Countries	**H_0: from TRD to GDP does not causality**			
	Positive Shock		Negative Shock	
	MWald	P-value	MWald	P-value
Brazil	13.196	0.001*	5.254	0.022*
India	0.731	0.392	0.196	0.658
Indonesia	0.012	0.914	0.000	0.992
South Africa	0.064	0.801	2.100	0.350
Turkey	0.095	0.758	0.005	0.945

(*) and (**) respectively show that it is rejected at the 5% and 10% levels.

Conference Proceedings

Perceived Effectiveness of Virtual Mentoring and Coaching on Teachers of English Language Learner's Pedagogical Practices During COVID-19

Erin A. Singer Ph.D.
Beverly J. Irby, Ed.D.
Elisabeth Pugliese Ph.D.
Hamada Elfaragy, Ph.D.
Rafael Lara-Alecio, Ph.D.
Fuhui Tong, Ph.D.
Texas A&M University School of Education and Human Development
Education Leadership Research Center, USA

Submitted: 13 September 2022
Accepted: 23 December 2022
Published: 30 December 2022

Cite As:
Singer E.A., Irby B.J., Pugliese E., Elfargy H., Lara-Alecio R. & Tong F.(2022). *Perceived Effectiveness of Virtual Mentoring and Coaching on Teachers of English Language Learner's Pedagogical Practices During COVID-19.* European Scientific Journal, ESJ.

Abstract

This mixed-method study aimed to determine teachers' perceptions of Project Massive Open Online Professional Individualized Learning (MOOPIL) Virtual Professional Development and the role it played in their pedagogical practices as they transitioned from face-to-face to online instruction during the initial months of the COVID-19 pandemic. We applied a mixed-method approach to understand the experiences of educators engaged in virtual professional development, virtual mentoring and coaching, and an online learning community during a global pandemic in the Spring of 2020. Participants reported various ways Project MOOPIL impacted their experiences as educators. Teachers' personal experiences in online learning through Project MOOPIL provided insight into the comparable experiences of students who were immersed in online education as well. Teachers reported a successful transfer of knowledge from this experience to their new distance learning domains that not only catered to the needs of English language learners (ELLs) in their classes but to native English speakers as well. Furthermore, through their participation in VPLCs and engagement in Project

MOOPIL VMC, participants demonstrated the ability to access and benefit from virtual collaborative support even when life got challenging. In this study, we examined virtual professional development intersectionality, distance learning, and the needs of emergent English speakers.

Keywords: Virtual mentoring, virtual learning, professional development, teachers' perceptions

Introduction

In March of 2020, all Texas kindergarten through 12th grade (K-12) schools and universities were closed until April due to the COVID-19 pandemic outbreak. As the April 10th deadline came for students and teachers to return to the classroom, Texas's governor announced that schools would continue to remain closed until the end of the school year (Swaby, April 17, 2020). During this time, school operations shifted from school buildings to kitchens, living rooms, and home offices. Many Texas teachers were given two weeks to create online content for their students regardless of grade or age range, and then were asked by their districts to teach those students virtually. This dynamic shift in protocol left many teachers at a loss; without proper training and equipment, instruction in virtual classrooms appeared limited. Before the pandemic, the goal of Project Massive Open Online Professional Individualized Learning (MOOPIL) (Irby, 2015) was to enhance teachers' instructional capacities through what Irby (2015) defined in triplicate as virtual professional development (VPD) with a unique combination of virtual mentoring and coaching (VMC) and virtual professional learning communities (VPLCs) as they earned the professional development hours required for continuing teachers' certification. The purpose of this study was to determine Texas teachers' perceptions of their participation in Project MOOPIL VMC, VPD, and VPLCs (Irby, 2015) and its impact on their experience and pedagogical practices teaching emergent English speakers as they transitioned from classroom to virtual instruction during the COVID-19 pandemic.

Context of the Study

This mixed-method study of teachers in Virtual Mentoring and Coaching (VMC) during COVID-19 is situated within the context of a more extensive study, titled Project MOOPIL, a five-year project using subsidized Virtual Professional Development (VPD) to increase the instructional capacity of teachers, administrators, parents, and paraprofessionals who serve English language learners (ELLs) and economically challenged students. The online learning modules contain specific objectives, instruction based on research, online discussion boards, reflection prompts, and assessments (Irby, 2015). Project MOOPIL is funded through the National Professional Development

Grant from the U.S. Department of Education, Office of English Language Acquisition (T365Z170192).

Over the five years of the grant, the goal of Project MOOPIL has been to prepare 2500 in-service teachers for making appropriate pedagogical decisions regarding the education of ELLs and to offer 100 administrators, 100 paraprofessionals, and 100 parent/family members professional development (PD) to better understand and implement instructional strategies for ELs at school and at home. This VPD was implemented by creating replicable online modules that are used with Virtual Professional Learning Communities (VPLC) or by individual teachers to improve their instruction. Each online module provides one hour of instruction. Teachers, administrators, and paraprofessionals engage in the online modules via Canvas and earn one hour of continuing professional education credit per module.

Irby et al. (2017) developed a multi-step, replicable process for Project MOOPIL modules with a process called L.E.A.D.E.R. (Leading Question, Engagement, Applied Research, Discussion, Example(s), and Reflection). The online modules begin with Leading questions that the teachers explore as they progress through the module. An Engagement activity follows, which can consist of a video, quote, or other activity to set the stage for the remainder of the module. In the Applied Research section, information from relevant research studies is presented. This is followed by a Discussion in which teachers can examine how they are using ELL strategies in their classrooms. Examples of applications of the topic are shared from the teachers' or the leaders' perspectives. Finally, there is a Reflection based on the Brown and Irby (2001) Reflection Cycle, which actually ends with the fifth step of transformation.

The project provides participants with a convenient online portal (Canvas) to improve the implementation of instructional strategies for English learners via online "work at your own pace" modules and live-recorded professional development seminars. The university provides professional development certificates for the units as continuing professional development for participants' professional evaluation and improvement. The online modules highlight various evidence-based strategies, are helpful in multiple learning environments, and are effective for a wide range of learners.

According to researchers (Irby et al., 2012), successful PD for teachers of ELLs does the following:

- Reflects best available research and practice related to teaching ELLs
- Facilitates teachers' development in subject-matter content, ESL/Bilingual teaching strategies, use of integrated technologies, and other essential elements in teaching standards-aligned curriculum
- Encourages teachers' improvement in practice through inquiry

- Involves substantial on-going time commitment on the part of the teachers and the developers
- Is assessed related to the impact on teacher effectiveness and ELLs' learning, and this assessment guides subsequent professional development efforts. (p. 2)

Project MOOPIL had effective implementation in its first four years, with widespread participation of 2,000 teachers, 163 administrators, 133 paraprofessionals, and 117 parents/guardians from Fall of 2017 to Spring of 2021. Participants reported positive learning outcomes and an appreciation for Project MOOPIL as an accessible vehicle for increasing their instructional capacity to educate English learners at school or at home. In this study, we sought to understand how Texas teachers applied what they learned and experienced during Project MOOPIL to meet these unprecedented needs during the COVID-19 pandemic.

Project MOOPIL utilized VMC in a VPLC to assist teachers, administrators, paraprofessionals, and parents in making appropriate pedagogical decisions for ELLs in K-12 classrooms. As COVID-19 spread throughout the United States, educators became increasingly concerned about how their students (ELLs or otherwise) transitioned to distance learning. Etchells et al., (2021) found that teachers in their study were spending extra time beyond their regular teaching duties to pivot their approaches and meet new student needs, and this demand took a toll on them.

COVID-19 and Schools

The novel coronavirus, or COVID-19, pandemic struck the United States in January of 2020. However, cases went largely undiagnosed and, by March of 2020, the nation was caught in the throes of a global epidemic. Under the Center for Disease Control and Prevention (CDC) advice, superintendents of school districts across Texas and the United States began to close schools following spring break in March, maintaining that they would reopen in early April. As COVID-19 cases continued to rise, it was uncertain how school districts would respond to the threat. Ultimately, most schools did not reopen their classrooms for the remainder of the school year, and schooling continued to occur remotely through virtual platforms.

During this time, Texas teachers were tasked by district administrations to make sure their students continued to receive effective instruction. Teachers had limited resources for creating content for students and little training in delivering online education. Additionally, students who had higher needs, such as socio-economically challenged students and emergent English speakers, faced obstacles to learning that included limited

access to technology and the internet at home, critical components required for participation in online learning (Lazarin, 2020; Means & Neisler, 2021).

Many Texas teachers could not return to their classrooms to gather materials before beginning online instruction, which added another layer of distress. Teachers felt pressure from their administration (Etchells et al., 2021), and they also were concerned about how to connect with students both virtually and outside of the online platforms (Miller, 2021). Their feelings around these experiences during that time ranged from depression and anxiety to frustration and anger.

In the spring of 2020, the Project MOOPIL team members virtually mentored 38 randomly selected elementary and secondary teachers for eight weeks. The participants were divided into groups to form VPLCs. The groups were created based on participants' availability. Each week, three to seven modules were assigned to the participants for review. Participants were responsible for completing each online module independently. Then, the participants met with mentors virtually to discuss and review the modules. The first two weekly sessions were facilitated solely by the project mentors. After that, each participating teacher selected and reviewed an online module with their cohort group, and they co-facilitated meetings with the mentor.

Aim and Research Questions

The purpose of this mixed-method (Creswell, 2012) study was to determine the perceived effectiveness of Project MOOPIL's VPD, VPLCs, and VMC (Lynch., 2021; Irby, 2015) on Texas teachers of ELLs pedagogical practices during the COVID-19 pandemic. The research questions that guided our study were (a) How did the shift from in-person to remote teaching impact educator pedagogical practices and experiences during the initial months of the COVID-19 pandemic? (b) What role did their engagement in Project MOOPIL VPD, VMC, and VPLCs play in this experience? and (c) How did educators incorporate content from Project MOOPIL (Lynch et al., 2021; Irby, 2015) into distance teaching practices?

Theoretical Framework

We drew on the theoretical assumptions from the transfer of learning theory (Perkins & Salomon, 1992; Salomon & Perkins, 1989) and the adult learning theory (Baumgartner et al., 2003; Knowles et al., 2015) in our study. The two theories contributed to the framework for the planning and development of this study.

We also drew from adult learning theory under the premise that adult learners examine and analyze information to form new knowledge. Adult learning theory's theoretical tenets highlight the importance of participants constructing their knowledge through discussion and reflections as well as

making connections to and building on their previous knowledge (Knowles et al., 2015). This was incorporated in the design of the initial Project MOOPIL study (Lynch et al., 2021; Irby, 2015). This theory was also appropriate for our research as it helped in interpreting how educators advanced their teaching pedagogies through rich opportunities of interactions with mentors, coaches, and peers.

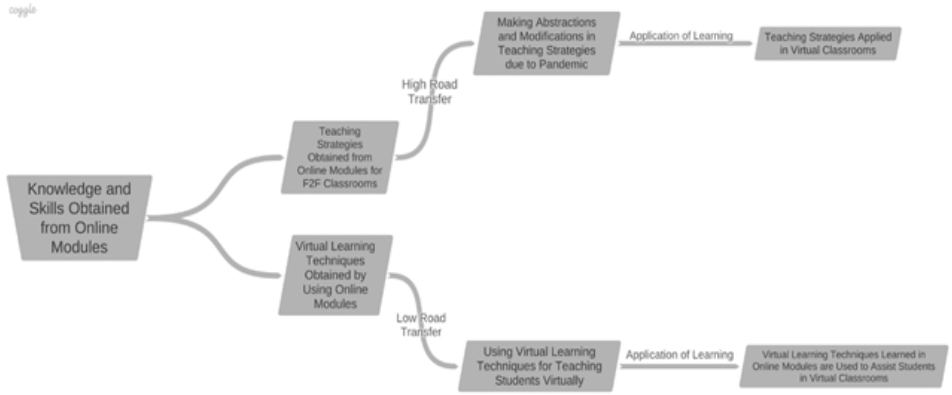

Figure 1. Conceptualizing Low and High Road Transfer of Learning

Transfer of Learning Theory

The transfer of learning theory lens offered insight into how individuals transfer learning from one context to another. Salomon and Perkins (1989) discussed two mechanisms, Low Road transfer and High Road transfer (1989). Low Road transfer occurs when individuals transfer learning between two similar contexts; it does not require much abstraction or modification from the learner. High Road transfer occurs when the learning context is different from the context in which the individual wants to apply it. This requires learners to make abstractions from and significant modifications to what they learned, so it is appropriate for the new context.

Our study utilized the theoretical assumptions from both the Low Road and High Road transfer mechanisms. Applying both was important as they were interrelated. Each perspective brought insight into the efficacy of Project MOOPIL VPD (Irby, 2015). We operated on the theoretical assumption that educators could transfer what they learned virtually in Project MOOPIL (Irby, 2015) to their virtual teaching spaces, demonstrating Low Road transfers. Although no one expected the sudden transition to virtual learning environments due to COVID-19, the High Road transfer mechanism could be employed and help us understand how teachers transferred their learning of pedagogical practices initially designed for face-to-face classrooms to their new virtual classrooms.

The High Road interprets the abstractions teachers must perform to modify their learned pedagogical practices to fit in the new virtual learning

environments for their students. The Low Road transfer is appropriate for interpreting how participants perceived the VMC content's transference to their physical classrooms and how they transferred their experiential learning from participating in virtual learning as students to their new responsibilities as online educators.

Adult Learning Theory

Adult learning theory asserts that adults are generally motivated to learn when they experience a need to do so. As adults learn, they have a new awareness of essential experiences. When they acknowledge the experience, they tend to appraise it and draw meaning and value from the encounter (Lindeman, 1926). Knowles (1975) expanded on this theory in his six characteristics of adult learners. The learner must first need to know something and recognize that need for learning. As the pandemic took over, teachers' need to reach their emergent English speakers was compounded by the need to learn how to engage them virtually, in line with how Knowles (1975) described the learner as self-directed.

Self-directed learning (SLD) is a well-recognized component of adult learning theory based on the premise that adults' interests determine their learning; therefore, they prefer to self-direct and assume responsibility for their learning (McCray, 2016). As teachers assume the responsibility for their learning, they are encouraged to reflect on the experiences throughout the modules. Teachers who engage in reflective learning "plan, monitor, and reflect upon their experiences" (McCray, 2016, p.52). Indeed, the teachers who participated in this study played a significant role in their own learning.

Literature Review

Virtual Professional Development

Across the literature, there has been increased interest in virtual professional development as it provides authentic and relevant training that works to enrich the overall teaching environment (Gosselin et al., 2016). Online professional development offers lucrative learning because of its flexibility and easy access to information (Gosselin et al., 2016; Zimmer & Matthews, 2022). Through online professional development, teachers are provided with professional development resources to which they would otherwise not have access (Carpenter & Munshower, 2020). Online professional development facilitates the exchange of ideas and encourages collaboration between professionals (Callahan, 2017).

Professional development for teachers has been at the forefront of "efforts designed to increase teaching practice and students' learning" (Balta & Eryılmaz, 2019, p.588). While there is no one size fits all approach to supporting teachers' professional learning throughout their teaching careers

(Campbell, 2017), mentoring is one standard method of professional development support.

Virtual Mentoring and Coaching

Historically, mentoring has taken place face-to-face, but with the onset and emphasis of technology in our daily lives, mentoring is shifting to also occur in virtual realms. Online mentoring is a convenient method for receiving input about ones' practice and can help support pre-service and novice teachers as they develop their identities as educators (Briscoe, 2019; Butler et al., 2013; Dorner & Kumar, 2017; Reali et al., 2020; Redmond, 2015). Mentoring plays an integral role in the development of teacher efficacy; "these types of mentorships can meaningfully enhance teachers' professional knowledge and support their sense of well-being in ways that would otherwise be difficult to achieve from textbooks or their peers" (Briscoe, 2019, p. 242). Redmond (2015) described the benefits and opportunities provided by online mentoring as:

- Enhanced access to mentoring opportunities because participants are not bounded by geographical constraints;
- Convenient access as most people now have their communication device in their pocket/handbag in the form of a smartphone;
- Reduced costs in time and money, no travel required or time away from job;
- A written record of interactions to be viewed/reviewed over time;
- Flexible access at a time convenient to participants and minimizing disruption to their daily commitments;
- Reduced impact of status in the mentoring relationship, less threatening, anonymity encourages the mentee to ask questions not likely to ask in person;
- Decreased pressure of an immediate response, asynchronous interactions provide time for the response to be more reflective;
- Enhanced opportunity for mentees to take responsibility for initiating contact and to play an active role in the discussion;
- Improved benefits to those skilled written communicators or those who are shy in person; and
- Increased awareness of issues of privacy and confidentiality when online. (p. 96)

Indeed, with the use of online meeting platforms such as Zoom, Go to Meeting, and Microsoft Teams during the pandemic, it seems that mentoring online has become somewhat more manageable over the last year. Teachers who were not familiar with online platforms were quickly introduced to Zoom

and other online meeting formats at the beginning of the pandemic to teach their students virtually. Teachers initially seemed to have difficulties with the suddenness in which they were thrust into the virtual world (Etchells et al.., 2021). However, educators soon recovered, using the tools with their online students more and more effectively. This outcome, in turn, led to their acceptance and continued use of the technology throughout the pandemic. This acceptance of the online format translated to teachers participating in online professional development through Project MOOPIL and participating in the VMC. Irby et al. (2020) indicated that during the time of the pandemic,

> (a) the mentors must continue communications and supports – this may be in small groups or individually, (b) the teachers need emotional support from their mentors during this time, and the VMCs must remember that this is about the person – as the priority. That action represents what a 'mentor' is, (c) The secondary part of this VMC is about coaching with a leading question such as 'How can we help you to support what the District/Campus is requiring? (p.1)

VPLCs, VPDs, and VMCs have become favorable methods for supporting teachers and their students with technology development (Lynch et al., 2021; Irby et al., 2017). Online mentoring provides decreased pressure, convenient access, and enriched opportunities for open and supportive relationships and friendships across space and time boundaries (Redmond, 2015).

Virtual Learning

Virtual learning can range from learning environments where individuals work primarily independently, experiencing little or no interaction with an instructor or other learners, to courses where students are highly engaged in interactive learning with the instructor and peers (Dabbagh et al., 2019; Janous et al., 2022). Online education has increased dramatically over the past ten years, and we continue to see a growing diversity among online learning students (Beasley & Beck, 2017). As a result, there is a continued need to meet the distinct needs of diverse learners in online settings; similarly, teachers and educators are called to honor these needs in a traditional face-to-face format (Beasley & Beck, 2017).

With the expansion of online learning, the investigation of its quality and its effectiveness has surfaced as a significant area of study and concern (Zhang & Lin, 2020). For example, in online learning environments, there may be fewer opportunities to interact with teachers and peers (Zhang & Lin, 2020). Because of this, curriculum designers must create ample opportunities for students to engage with teachers, classmates, and the learning content. These practices also improve student motivation (Zhang & Lin, 2020).

There is a boom in the relevancy of online professional development as it provides authentic and responsive training that works to enrich the overall teaching environment (Gosselin et al., 2016; Zimmer & Matthews, 2022). Its flexible nature and the ease with which teachers can access the information has led to a lucrative approach to professional development (Gosselin et al., 2016). Through VPD, teachers are provided with professional development resources to which they may not otherwise have access (Carpenter & Munshower, 2020). VPD is a productive way to facilitate professional development practices because it supports the exchange of ideas and encourages collaboration between professionals without sitting side by side (Callahan, 2017; Zimmer & Matthews, 2022).

Virtual communication has become the norm in everyday life (Owen et al., 2018). Bringing professional development into the virtual sphere has aided the increased use of synchronous tools such as webinars and video conferencing, through which professionals can communicate in real-time. Similarly, it has also increased the use of asynchronous platforms like email and discussion forums that allow professionals to utilize professional development when most convenient for them (Butler et al., 2013; Owen, 2016). Virtual realm development has also contributed to increased exposure to diverse ways of thinking, subsequently expanding previous ways of knowing. Technology increased educators' ability to interact and form relationships with other professionals who may have views and cultural backgrounds different from their own (Owen et al., 2018; Hamadneh, 2015). In addition to broadening belief systems, VPD can also bring teachers with similar goals and needs together (Carpenter & Munshower, 2020). VPD is helpful as it inspires creative thinking and collaboration. It is also beneficial for teachers who work in rural districts that may lack teams of educators teaching similar subjects with similar goals and needs, with whom they can converse (Carpenter & Munshower, 2020).

Methodology

We applied a mixed method research approach (Creswell, 2012). In it, we used an equal status qualitative-quantitative design (Johnson & Onwuegbuzie, 2004). Data were gathered from a closed- and open-ended survey with a follow up interview. Both the quantitative and qualitative phase findings are integrated into the interpretation of the findings.

Participants

The Project MOOPIL team members sent emails to teachers in our partner school districts to invite them to participate in this study. A total of 145 teachers expressed interest in the study. Of the 145 individuals who

expressed interest, 50 were randomly selected through the random selection tool in Excel to participate in this study.

The virtual nature of this study elicited a diverse group of participants. Initially, the participants included 15 Hispanic, 13 African American, and 22 White teachers. Ultimately, 38 teachers completed the study. Of the 38 educators who finished, eight were male, and 30 were female. They taught various communities across Texas in elementary and secondary grade-levels in a range of subjects, including English as a second language (ESL), English, Mathematics, Science, Social Studies, Music, and Physical Education.

Data Collection

We collected the data in this study through Institutional Review Board (IRB 2017-0764D) approved surveys and interviews. A survey was sent out to 38 participants, and we received 28 responses. The survey included questions about how likely participants were to incorporate and share MOOPIL modules in their own school PLCs, how they have specifically used the material in the online modules to virtually work with ELs, and how their approach to teaching has shifted due to not being in the classroom because of the COVID-19 pandemic.

During the last group meeting, coaches inquired whether participants were interested in volunteering for a 15-30-minute interview. Participants were interviewed on how Project MOOPIL content and practices had impacted their teaching approach and how they adjusted to teaching during COVID-19. Participants were informed that involvement in the interview was additional and voluntary and was not a requirement to complete Project MOOPIL. Six of the 38 participants volunteered to be interviewed. All participants were aware of this research and consented for their information to be use.

Interview Protocol and Survey

The survey consisted of five three-point Likert scale questions and 12 short answer questions. We used the survey to gather initial demographic information about our participants and information about teacher experiences with VPD and in their virtual mentoring cohorts during the pandemic. The survey questions included such items as: how engaged the participants were in the discussions, to what extent did the mentor guide and facilitate the sessions, and how likely the participants were to use the online modules in their own professional learning communities. The survey was reviewed for its face validity by three experts in VMC and VPD. Feedback was provided and the survey was altered slightly for clarity.

We interviewed six participants about their perceptions of Project MOOPIL changing their pedagogical practices as they moved from face-to-face to online teaching during the initiation of the COVID-19 pandemic.

Interviewers asked participants the following four questions a) how have you as a teacher used Project MOOPIL material for English learners in your virtual spaces during this time; (b) in what ways has your approach to teaching shifted while you are not in the classroom with your students; (c) how has Project MOOPIL impacted your virtual teaching experience; and, (d) how have you been coping and adapting to teaching from home. The various themes and codes that emerged from participants in answering these questions are discussed in the findings and discussion section.

Data Analysis

We prompted teachers through surveys and interviews on their experiences in Project MOOPIL during the COVID-19 pandemic. Because this was an equal status mixed method approach, we report and interpret together the quantitative and qualitative data as relevant. Of the 28 teachers who responded to the survey, 85% said that they were "very engaged" in the discussions with their virtual mentors and 85.7 % were extremely likely to use the VPD with their own professional learning communities. In addition, 96% of the participants indicated that the discussion of the modules was detailed or very detailed and 64% of the participants said that the mentors contributed "to a large" extent in guiding them, while 35.71% said that the mentors aided the discussions "somewhat."

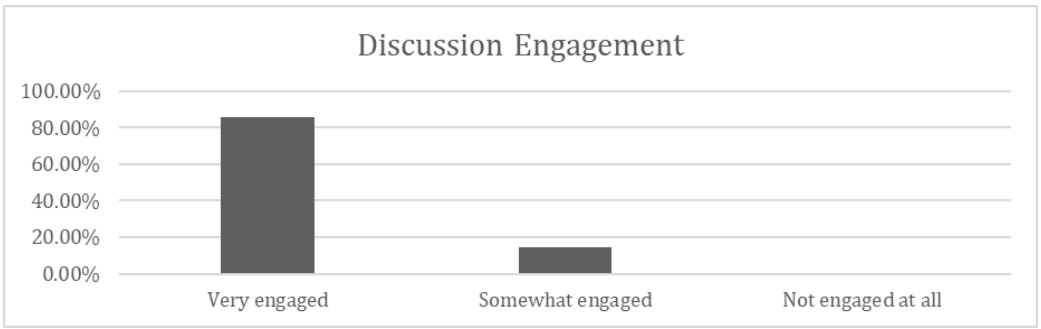

Figure 2. Participant Engagement in Discussions

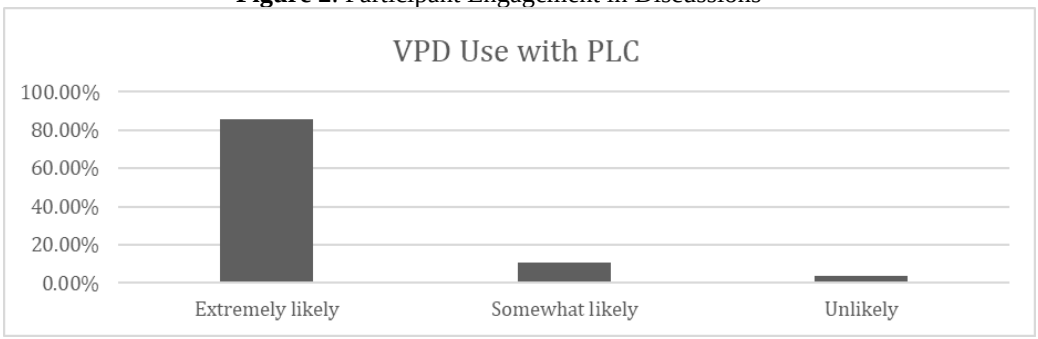

Figure 3. Use of VPD with PLCS

Qualitative Analysis

We processed data through inductive content analysis (Creswell, 2012). We developed a categorical framework for the content analysis from the questions asked in our survey and interviews related to (a) online module VMC PLC impact, (b) COVID impact/ teaching shift, and (c) online module in Virtual Spaces. All participant interviews were transcribed and reduced down to units. Units for analysis were statements, phrases, or keywords. We sorted units from interviews to determine rich and recurring themes among participant experiences.

We identified three main themes with sub-themes from their responses related to (a) Project MOOPIL's perceived impact on participant virtual teaching experiences during the COVID-19 pandemic; (b) the shift which took place due to the unprecedented circumstances; and (c) ways educators transferred learned content originally designed for traditional educational settings for ELs to their new virtual spaces. All teacher participants reported a methodological shift of some kind in their approach to teaching due to the change to virtual learning platforms, participation in Project MOOPIL, or a combination of the two.

Trustworthiness and Credibility of the Quantitative and Qualitative Components of the Study.

To enhance the study's trustworthiness and credibility, the survey was validated by three experts in VMC and VPD. Feedback was provided and the survey was altered slightly for clarity. For the qualitative component, we used member-checks with participant responses during interviews to ensure we understood them accurately. Additionally, we engaged in reflexive practices to acknowledge biases during data collection and analysis, journaling independently and reflecting on the research team aloud. We combed through data and determined themes as individuals initially and then met as a team to analyze data a second time, resorting together, resolving any inconsistencies, and strengthening reliability among the research team. Finally, we used triangulation from participant responses to the questions in interviews and surveys to enhance trustworthiness (Creswell & Poth, 2017; Creswell, 2007; Ely et al., 1991; Erlandson et al., 1993; Lincoln & Guba, 1985).

Consideration

While we were able to recruit an ethnically, experientially, and regionally diverse group of teachers from rural, urban, and suburban school districts across Texas, our sample of participants evolved as this study progressed. We started the study with 50 educators. But, as the COVID-19 pandemic spread throughout Texas and the United States, teachers' burden in adjusting to the need for online teaching became clear. Many participants

became disheartened with the amount of extra work and time they had to put in for students and parents. Some began missing meetings, and several participants dropped out completely, citing overwhelming responsibilities and stress. This may have impacted the sample of our participants and the findings we recorded.

Other constraints included technology use and internet connectivity. Several teachers had issues being disconnected from the video conferences due to unreliable internet service. While many of the participants were able to rejoin, others dropping out of the online meeting and logging back on repeatedly became an issue. Several participants did not use their cameras during sessions because the computers supplied by their schools did not include cameras. In contrast, several others used their cellular devices to connect with meetings. Participants in the study may have had interruptions to accessing content, mentoring and coaching, and their peers.

In addition to technological challenges, motivation to complete the courses and an inability to film teaching demonstrations became an issue toward the end of the study. More teachers began to drop off in late April as school district demands on participating teachers increased. With the added workload, some teachers decided to sever their commitment to Project MOOPIL entirely. Furthermore, teachers could not film themselves using the strategies they had learned in the online modules as classes were no longer being held in schools. Because of this, our findings are perceptions of teacher experiences rather than observations.

Results and Discussion

As discussed in the theoretical framework, we utilized adult learning theory (Baumgartner, 2003; Knowles, 2015) and transfer of learning theory (Perkins & Salomon, 1992; Salomon & Perkins, 1989) in this study. Teachers in the study were initially motivated to participate in the VPD because of their need to provide in-class support for their ELs and assumed responsibility for their learning. With this learning, participants also uncovered online strategies by participating in the PD that would help them teach their own students online. After completing the PD modulus, participants began to reflect (Jarvis, 2001) on what they learned in the PD and expressed their thoughts with the mentors.

Impact on Participants

Participants reported various ways in which Project MOOPIL impacted their experiences as educators. Teachers' personal experiences in online learning through Project MOOPIL provided insight into what their students immersed in online education might be experiencing as well. They also reported that their enrollment in the project led to an enhanced awareness

of EL needs and strategies to meet them. Finally, we found that VMC and participant engagement in PLCs cultivated a valuable sense of community support.

Experience in Online Learning

When school administrators were confronted with COVID-19, they were required to make decisions regarding their institutions' operation. As Texas schools eventually closed, many transitioned learning to other distance learning pathways. While not all instruction went from the physical classroom to online, many Project MOOPIL participants reported this change in their schools. While some participants reported having engaged in online learning before their involvement in Project MOOPIL, some participants had not experienced online learning until their participation in Project MOOPIL. Among both groups, participants whose teaching was moved to online platforms shared that their experience in Project MOOPIL's virtual format offered a deeper understanding of what their students might be experiencing as they learned virtually.

The learning curve to navigating new and unfamiliar online learning spaces is often steep. Through Project MOOPIL, educators had recent experience as virtual students themselves. They were able to recall the challenges they faced as students and anticipate their students' needs in this regard. Furthermore, participant experience in Project MOOPIL gave them a foundational understanding of how to navigate online learning platforms while also emphasizing the value of patience as their students became familiar with new technology, demonstrating a Low Road transference (Salomon & Perkins, 1989). One educator said, "Without having tried to learn online, I would have been underprepared for this experience." Another stated, "It definitely has made me more sympathetic to my students as they navigate learning online." Another educator echoed, "this has helped me to see things from the student's point of view."

Finally, their online professional development experience through Project MOOPIL helped teachers develop an appreciation for accessibility. During a difficult time when people were separated from one another to keep them safe and healthy, Project MOOPIL was already formatted to serve them in an accessible way. Some participants recognized this convenience and accessibility; one stated, "It is innovative. It shows how PD can work in the future. It allows for distance and proximity to no longer be limitations for teacher development," which demonstrates Knowles (2015) and Baumgartner et al. (2003) theories that adults are motivated to learn when they experience a need to do so.

Awareness of ELL Needs and Strategies

One of the most consistently reported themes in this study was how participation in Project MOOPIL ignited teacher awareness of EL student needs and provided them with a cornucopia of high-impact strategies to meet such requirements. One educator wrote, "I am more mindful of English learners and strategies that support language development." Another said, "these modules made me more aware of the student needs and how I have to make it a point to meet them. This has been an eye-opening experience." We go into more depth about the strategies they drew from in a later section.

Participation in Project MOOPIL led educators to place ELL learning at the forefront of their planning and teaching. One participant said, "It has helped keep the needs of my students in mind when creating assignments." Teacher involvement heightened an awareness of ELL needs that otherwise may not have been present in virtual teaching approaches had there been a global pandemic before they participated in Project MOOPIL. One teacher reflected, "I think I have been more intentional with different assignments because I've been thinking about ways to incorporate as many supports as I can since I can't physically give them everything in the classroom." While some strategies may have been taken for granted in a physical space prior to COVID-19, they were subsequently more intentionally employed in the virtual arena. One participant suggested that participation in Project MOOPIL "will affect my entire approach, not just virtual teaching but in the classroom as well. Mainly, the knowledge and awareness gained will constantly be in planning lessons and assignments/assessments."

While educators transferred new strategies to support ELs, they were also conscious of the hurdles their non-ELs faced as learning moved out of the physical classroom. One tenet of Project MOOPIL and EL education is that the teaching strategies that serve ELs in the classroom also enhance the learning experience of non-ELs. This premise was also frequently recognized by participants; one teacher supported this claim stating "the strategies that work well for ELL students are good for all students as well." Participants shared an understanding that their approaches to teaching EL students were also beneficial for non-ELs. Teachers reported the wherewithal to serve all students sensitively, regardless of English fluency. One teacher said, "I feel like I have to assume that all students need all of the extra supports and resources because I am not there to monitor their comprehension and growth." Project MOOPIL participants not only received content knowledge by completing online learning modules, they also benefited from engaging with their virtual learning community cohort and virtual mentoring and coaching. We found that while the educational landscape rapidly shifted, participants found solace among their peers and mentors in Project MOOPIL. One educator explained, "My PLC was extremely helpful and supportive by

sharing with the group what they were going through to help build a common experience". Another teacher participant echoed the reciprocal notion of community, citing their willingness to help others.

COVID-19 and a Teaching Shift

As state, district, and school leaders acknowledged the crises associated with COVID-19, they began to make concessions in the traditional approaches to student learning in the United States. Participants in our study reflected on the shift from traditional practices and its impact on their experience as educators. They cited many struggles and, from those, some participants developed creative strategies and new outlooks to adjust to a new way of life. Loss of autonomy, lack of technology access, and student fallout were among the obstacles they described.

Student Fallout

Perhaps the most significant hurdle educators encountered was the challenge of engaging their students. Teachers struggled with a lack of student engagement, whether it was completing workbooks sent home or participation in virtual learning spaces. One educator reported an inability to reflect on how they adjusted to the new online learning environment "because students don't attend the hangout." We discussed the role parental presence played in student engagement in another section. Technology and access to resources was also reportedly responsible.

Technology

For many educators, their transition to remote learning was coupled with technological additions. This new factor became foundational to many learning spaces and contributed to a disconnect between teacher and student. One teacher called attention to the inequities that can contribute to opportunity gaps, stating, "I see the need for all students to have access to a device and internet to make an impact on learning." Another teacher highlighted the struggle when they stated, "The approach was somewhat difficult due to the fact that 50% of my students did not have devices or any internet." A teacher built on this notion when they responded, "Technology and an 'I can't do this' attitude became major hurdles."

Students were either unable to access the resources necessary to engage virtually (e.g. Computer devices, WIFI, etc.) or, if they did have access to the technology, they faced challenges learning how to log in correctly and click the right buttons. One teacher reflected, "I am more of a technical support person now. I have made more Google forms and spreadsheets in the past few months than in my entire ten years of teaching."

Lack of Autonomy

Though some teachers eventually mastered technological hiccups, they still faced struggles. Among the many challenges posed by COVID-19, the elimination of classes or the inability to control what teachers taught became apparent in several participants' statements. During the shift from in-person to distance learning, administrators faced critical and prompt responses. Some decided to streamline the process for all of their educators. Several of the educator participants reported a loss of agency over the content and how it was delivered. Some schools outsourced their curriculum development to external vendors or used existing online modules, while others delegated the task of creating virtual teaching resources to instructional coaches. These practices led to a loss of autonomy and input for some participants. When asked how Project MOOPIL content impacted their virtual teaching approach, one participant stated simply, "I am limited and not able to have much input."

Resilience and Creativity

Though educators were presented with numerous difficulties and setbacks in the Spring of 2020, they also demonstrated a sense of resiliency and creativity. Educators who faced new challenges from remote learning also encountered opportunities for creativity and resourcefulness in their approaches. One educator reported a sense of gratitude for this new system: "I feel like I am always working in small groups, so I am enjoying quite a bit of one-on-one or small group teaching. I am able to go into much more depth with some students and also reteach it a bit easier since I have a smaller number of students' chatting' with me." Another teacher had a similarly optimistic mindset: "It has been a huge shift. I have basically gone from almost no online activity to 100% online. It has definitely been a challenge, but I believe a lot of really good things will come from it in education as a whole."

Teachers demonstrated an ability to expand their approaches by using techniques they acquired in Project MOOPIL (described later in the study) and some of their resourcefulness. One educator shared an approach in which they addressed limitations: "I try to keep the students engaged through checking up on them by email and during office hours and phone calls." Another shared, "I have to use more strategies to ensure the information is understood. I am using more visuals and asking more questions, especially if they are quiet." Teachers made themselves available through various modes: "We communicate a lot through email, and when students have specific questions about a problem, I find myself explaining the material by email."

Parent Engagement

Lack of parent involvement is something many educators encounter whether they are experiencing a global pandemic or not. There are modules offered through Project MOOPIL which emphasize the role parents play in student learning. Participants also noted this role as their practices shifted from in -class to at-home learning. One educator described the way MOOPIL content impacted their virtual teaching approach, making them "...more aware of the importance of connecting to parents and sharing cultural differences so they can appreciate it too." Another participant cited their relationship with parents as a necessity that emerged from the challenges of virtual teaching, "It has been more difficult for us to reach out to our kids, and contact is mainly being made with or through parents." Though this example highlights the challenge to direct teacher/student contact, it also unveils the benefit of drawing in parental cooperation and a group approach to learning. Students may be negatively impacted when parents are unable to participate in their children's education, perhaps due to language barriers, economic constraints, or other obstacles. One educator acknowledged this struggle when they said, "I am striving to create lessons that will both extend thinking and be easy enough that the kids can guide themselves through independently because of lack of help at home."

Grace over Grades

Assessments and student outcomes often propel educational systems. When the pandemic hit, the educational system could no longer function in the same structure as it had previously existed, and educators were forced to adjust their perceptions about how classrooms should look. Study participants demonstrated an awareness of the potential impact a global pandemic and new remote learning approaches could have on their students' social and emotional wellbeing. One teacher said, "I think about how students will respond to the content, and what else I can include that can help them not be anxious." Many participants reported a shift in their expectations once learning moved from the physical classroom to remote learning. "I have kept this mentality 'Grace over Grades' because, for many students, school is not a priority right now. Surviving is their main priority."

Conclusion

Project MOOPIL was intended to help educators who engage in VPD transfer module content to the work they do in traditional in-person learning spaces (Irby, 2015). Once COVID-19 forced schools to adapt their teaching and learning approaches to virtual spaces, educators faced a new frontier. Though the new format had the potential to complicate instruction and lead to further opportunity gaps for English learners, participants reported sensitivity

to these students during that time. There was a heightened sense of awareness reported by one participant. "Since all of my time is online, I have had to work on being even more aware of my ELs during my instruction time. I do videos of content instruction so that students can watch more than once if needed." In this case, online instruction could enhance EL learning outcomes with the added ability to access and replay course content repeatedly.

In this study, we found many participants demonstrated High Road transfers by reportedly shifting the knowledge acquired in Project MOOPIL for students in physical classrooms and transferring it to their practices in the virtual realm. Educators reported that the information they learned in Project MOOPIL held a continued sense of applicability, regardless of the environment. One participant referred to content they learned in the modules as "idea nuggets...surrounding the various ways to engage students in conversation and through writing activities." Another said that during virtual teaching, "It [Project MOOPIL] has given me more suggestions and strategies to use when teaching and reviewing with my scholars." Participants demonstrated the ability to transfer high-impact strategies for English learners in the classroom to their new virtual learning spaces.

Implications

The global pandemic demanded that teachers rapidly adjust their approaches to instruction. Student success through distance learning is now more relevant than ever and, within that concept, it is critical to recognize that opportunity gaps exist for many students in U.S. classrooms. English learners and students experiencing economic disparity often do not have access to the same opportunities as other students who are not limited financially or linguistically (Carter & Welner, 2013). English learners may not have home computers or access to reliable wi-fi connections, making it difficult for students to complete online lessons or log into online classes. Some scholars (Kuhfeld & Tarasawa, 2020) have expressed concerns fear that COVID-19 has further exacerbated this gap through the setbacks brought on by distance learning. Students' limited access to technology and the internet, parents juggling new responsibilities in the home, standardized approaches to teaching and learning, lack of student engagement, unmet expectations, and personal stressors from the pandemic have all been cited as hurdles to student achievement in 2020.

We found VPD effective in supporting educators' perceived efficacy and uncovered struggles educators experienced as they virtually tended to their own students' development, which was also addressed in VPD and VPLCs. Thus, it would be beneficial to examine the challenges participants described in this study. It would also be helpful for future researchers to study student experiences in virtual learning spaces to better understand what it is like for

both emergent English speakers and native speakers in K-12 online learning spaces. When we understand students' virtual learning experiences, we can cater interventions to meet existing needs. We observed an example of such in this study when one teacher reported attaching videos to their lessons so English learners (and all their students for that matter) could view and reference them repeatedly. This was a scaffolding system uncommon in face-to-face learning environments. This ingenuity demonstrated the gains to be made when teachers consider the individual needs of all students, are strategic, and capitalize on unusual circumstances. As technological advances continue to develop and shape the educational landscape, researchers and educators must continue to evaluate ways to integrate them that enhance the experiences of historically marginalized students.

Teachers reported a shift in pathways for student success based on their participation in VPD and VPLC. Teachers in this study were cognizant of student anxiety and shared a desire to be flexible and gracious in an effort to ease it. They reported a change in expectations, the implementation of individualized student learning, and a balanced approach to time management. Expected outcomes were not standardized; instead, students were encouraged to do what they could in ways that were appropriate for them. Future researchers could study the adoption of this flexible approach to learning and examine what outcomes develop. We found the COVID-19 pandemic and subsequent move to virtual learning created opportunities for teachers to try new approaches, and some yielded favorable results.

Project MOOPIL was designed to support educator efficacy as they work with a substantial and growing population of ELs in U.S. schools. In this study, we found that measures Project MOOPIL provides to prepare effective educators of ELs, such as VMC, VPLCs, and the content offered through VPD modules, are also valuable when student learning moves out of the classroom and into their homes. Teachers reported a successful transfer of learning in this experience into their new distance learning domains that not only catered to the needs of ELs in their classes but to native English speakers as well. Furthermore, through their participation in VPLCs and engagement in Project MOOPIL VMC, participants demonstrated the ability to access and benefit from virtual collaborative support, even when life became challenging.

References:

1. Balta, N., & Eryılmaz, A. (2019). The effect of the 'teacher-led PD for teachers' professional development program on students' achievement: An experimental study. *Teacher Development, 23*(5), 588-608. https://doi.org/10.1080/13664530.2019.1659176
2. Baumgartner, L. M., Lee, M. Y., Birden, S., & Flowers, D. (2003). *Adult Learning Theory: A Primer.* Information Series.

3. Beasley, J.G., & Beck, D. (2017). Defining differentiation in cyber schools: What online teachers say. *TechTrends, 61*(6), 1–10. https://doi.org/10.1007/s11528-017-0189-x
4. Brown, G. & Irby, B.J. (2001). *The principal portfolio (2nd Ed).* Corwin Press.
5. Butler, A.J., Whiteman, R.S., & Crow, G.M. (2013). Technology's role in fostering transformational educator mentoring. *International Journal of Mentoring and Coaching in Education 2*(3), 233-248. https://doi.org/10.1108/IJMCE-06-2013-0037
6. Callahan, C. (2017). Asynchronous Virtual Conversations as Professional Development for In-Service History Teachers. *International Journal of Interdisciplinary Educational Studies, 12*(2), 27-42. https://doi.org/10.18848/2327-011x/cgp/v12i02/27-42
7. Carter, P. L., & Welner, K.G. (2013). *Closing the opportunity gap: What America must do to give every child an even chance*. Oxford University Press.
8. Carpenter, D., & Munshower, P. (2020). Broadening borders to build better schools: Virtual professional learning communities. *International Journal of Educational Management, 34*(2), 296–314. https://doi.org/10.1108/IJEM-09-2018-0296
9. Creswell, J.W. (2007*). Qualitative inquiry and research design: Choosing among five approaches.* Sage.
10. Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research. (4th edition).* Pearson.
11. Creswell, J.W. & Poth, C.N. (2017). *Qualitative inquiry and research design: Choosing among five approaches*. *(4th edition.).* Sage.
12. Dabbagh, N., Marra, R.M. & Howland, J.L. (2019). *Meaningful online learning: Integrating strategies, activities, and learning technologies for effective designs.* Routledge.
13. Day, S. B., & Goldstone, R. L. (2012). The import of knowledge export: Connecting findings and theories of transfer of learning. *Educational Psychologist, 47*(3), 153-176. https://doi.org/10.1080/00461520.2012.696438
14. Dorner, H., Misic, G., Rymarenko, M. (2020). Online mentoring for academic practice: Strategies, implications, and innovations. *Annals of the New York Academy of Sciences.* https://doi.org/10.1111/nyas.14301
15. El Janous, Y., Laafou, M., El-Hassouny, E. H., & Madrane, M. (2022). Teachers' Perception of the Moroccan ICT Portal of the Ministry of Education. *European Scientific Journal, ESJ*, *18*(12), 155. https://doi.org/10.19044/esj.2022.v18n12p155

16. Ely, M., Anzul, M., Friedman, T., Garner, D., & Steinmetz, A.C. (1991). *Doing qualitative research: Circles within circles*. Falmer Press.
17. Erlandson, D.A., Harris, E.L., Skipper, B.L., & Allen, S.D. (1993). *Doing naturalistic inquiry: A guide to methods.* Sage.
18. Etchells, M.J., Brannen, L., Donop, J., Bielefeldt, J., Singer, E.A., Moorhead, E., Walderon, T. (2021). Synchronous teaching: Asynchronous Trauma. *Social Sciences & Humanities Open 4*(1) 100197.
19. Gosselin, K. P., Northcote, M., Reynaud, D., Kilgour, P., Anderson, M., & Boddey, C. (2016). Development of an Evidence-based Professional Learning Program Informed by Online Teachers' Self-efficacy and Threshold Concepts. *Online Learning, 20*(3), 178–194. https://doi.org/10.24059/olj.v20i3.648
20. Hamadneh, I. M. (2015). Training needs for faculty members at Al-Albayt University from their perspectives in the light of some variables. *European Scientific Journal, ESJ*, *11*(25). Retrieved from https://eujournal.org/index.php/esj/article/view/6212
21. Irby, B.J., Guerrero, C., Lara-Alecio, R., Tong, F., & Rodriguez, L. (2012). Professional development principles for teachers of English language learners. *School Leadership Review*, *7*(1), 36-46.
22. Irby, B.J. (2015). Editor's overview: Virtual mentoring and coaching (VMC). Mentoring & Tutoring: Partnership in Learning, *23*(3), 183-186. http://doi.org/10.1080/13611267.2015.1085695
23. Irby, B.J, Sutton-Jones, K. L., Lara-Alecio, R., & Tong, F. (2017). From MOOCs to MOOPILs: pushing the boundaries of virtual professional development and learning for teachers. *International Journal of Information Communication Technologies and Human Development 9*(1), 34-47.
24. Irby, B.J, & Pugliese, E. (2020). Mentoring takes on different forms as we physically distance, but personally engage. *Mentoring & Tutoring: Partnership in Learning, 28*(1), 1-5. DOI:10.1080/13611267.2020.1751540
25. Jarvis, P. (2001). *Learning later in life: An introduction for educators and careers.* Kogan Page.
26. Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26. https://www.jstor.org/stable/3700093
27. Knowles, M. S., Holton, E. F., & Swanson, R. A. (2015). *The adult learner: the definitive classic in adult education and human resource development. (8th ed.).* Routledge.

28. Kuhfeld, M., & Tarasawa, B. (2020). *The COVID-19 slide: What summer learning loss can tell us about the potential impact of school closures on student academic achievement*. NWEA Research.https://www.nwea.org/content/uploads/2020/05/Collaborative-Brief_Covid19-Slide-APR20.pdf
29. Lazarin, M. (2020, June) COVID-19 *Spotlights the Inequities Facing English Learner Students, as Nonprofit Organizations Seek to Mitigate Challenges.* Migration Policy Institute.
30. Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Inquiry*. Sage.
31. Lynch, J., Irby, B., Tong, F., Lara-Alecio, R., Zhou, Z., Singer, E.A. (2021). Massive open online professional individualized learning: Using virtual professional development to build teachers' instructional capacity for English learners. *The Electronic Journal for English as a Second Language, 25*(2).
32. McCray, K. H. (2016) Gallery Educators as Adult Learners: The Active Application of Adult Learning Theory. Journal of Museum Education, 41(1), 10-21. https://doi.org/10.1080/10598650.2015.1126058
33. Means, B., & Neisler, J. (2021) Teaching and learning in the time of COVID: The student perspective. *Online Learning, 25*(1), 8-27. https://doi.org/10.24059/olj.v25i1.2496
34. Merriam, S. B., Caffarella, R. S., & Baumgartner, L. M. (2007). *Learning in adulthood: A comprehensive guide (3rd ed.).* John Wiley & Sons Inc.
35. Miller, K.E. (2021). A light in students' lives: K-12 teachers' experiences (re)building caring relationships during remote learning. *Online Learning, 25*(1), 115-134.
36. Owen, S. (2016). Professional learning communities: Building skills, reinvigorating the passion, and nurturing teacher well-being and "flourishing" within significantly innovative schooling contexts. *Educational Review, 68*(4), 403–419. http://dx.doi.org/10.1080/00131911.2015.1119101
37. Owen, H., Whalley, R., Dunmill, M., & Eccles, H. (2018). Social Impact in Personalized Virtual Professional Development Pathways. *Journal of Educators Online, 15*(1), 1-14.
38. Perkins, D. N., & Salomon, G. (1992). Transfer of learning. *International encyclopedia of education, 2*, 6452-6457.
39. Redmond, P. (2015). Discipline specific online mentoring for secondary pre-service teachers. *Computers & Education, 90*, 90-104. https://doi.org/10.1016/j.compedu.2015.08.018
40. Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: Rethinking mechanism of a neglected phenomenon. *Educational*

psychologist, 24(2), 113-142. https://doi.org/10.1207/s15326985ep2402_1

41. Swaby, A. (2020, April 17).Gov. Greg Abbott keeps Texas classrooms closed for the remainder of school year. *Texas Tribune*. Retrieved from https://www.texastribune.org/2020/04/17/gov-greg-abbott-keeps-texas-classrooms-closed-remainder-school-year/
42. Zimmer, W.K. & Matthews, S.D. (2022). A virtual coaching model of professional development to increase teachers' digital learning competencies. *Teaching and Teacher Education, Volume* 109. https://doi.org/10.1016/j.tate.2021.103544

Conference Proceedings

The Black Sea - the Geopolitical Springboard of the Region

Ekaterina Zakaradze
Assistant-professor, PhD in Public Administration
Grigol Robakidze University, Georgia
Khatuna Muradishvili
Associate professor, PhD in Public Administration
Grigol Robakidze University, Georgia

Submitted: 13 September 2022
Accepted: 15 December 2022
Published: 30 December 2022

Cite As:
Zakaradze E. & Muradishvili K. (2022). *The Black Sea - the Geopolitical Springboard of the Region.* European Scientific Journal, ESJ.

Abstract

Security and stability are essential for stable development, successful integration into global political and economic systems, and sustainable economic growth in the Black Sea region and Black Sea countries, including Georgia. During the Cold War, the Black Sea was "divided" into the Republic of Turkey (as a member of NATO) on one hand, and the countries of the former Soviet Union on the other. After the end of the Cold War, the strategic balance in the Black Sea region has undoubtedly changed - the role and geopolitical-economic importance of the Black Sea has noticeably increased. The Black Sea coastal states, including Georgia and Ukraine, have been given a new geopolitical role, new opportunities, and new challenges.

Keywords: Black Sea, geopolitics, security, transit hub

Introduction

The Black Sea region has always been a place of intense socio-economic relations, and it has increasingly transformed into a center of attraction for the growing political and economic interaction of various parties. Unfortunately, the political interest in creating dividing lines and zones of influence has a negative impact on the political and economic situation of the region, as well as on the overall picture of society-to-society relations.

The aggression carried out by Russia against Georgia and Ukraine dramatically changed the political and security balance in the Black Sea region and in the long term posed a serious threat to the stability and insurance of Europe. Therefore, NATO's involvement in the process of strengthening the security of the Black Sea is extremely important.

Despite the fact that the safety of the Black Sea region is becoming more and more relevant and it is one of the important challenges for global security, this issue is little studied from an academic point of view, and the interests and policies of the states towards this region are often not clear and consistent.

Main Part

From a geographical point of view, the Black Sea is the only contact point for Georgia with the Euro-Atlantic space, therefore integration with the Black Sea is Georgia's unwavering demand. In addition, the security of the Black Sea region has a particularly sensitive impact on Georgia's trade, transit, and economic opportunities. After Georgia expressed its desire to join the Silk Road project and become a kind of „transit hub“, the safety of the Black Sea became an even greater priority for the country. However, the security issue of the Black Sea region is extremely important for Georgia. Especially in the context of NATO integration and the deepening of relations with the Alliance.

Recently, the role of Georgia in the security of the Black Sea has been quite relevant. Here, the question arises - what role should Georgia play in the security of the Black Sea, when the country, among other things, wants to become a member of the North Atlantic Treaty Organization? - If there is a unified NATO proactive strategy, Georgia should have a decisive role, although it should work more actively for it.

First of all, the most important thing is how active Georgia will be in strengthening the security of the Black Sea. Strengthening the surety of the region should be primarily in the interest of the local states, and they should offer their partners a way out of the most difficult situation the region is currently in (Chitaladze, A. 2017).

It is also noteworthy that Georgia and Ukraine do not stand together in this matter and these two countries do not speak the same language. We support each other with "words" that we are partners, although no one can name any specific actions that Ukraine and Georgia have jointly implemented for the security of the Black Sea.

The second main shortcoming, in the context of expressing the role of Georgia, is the suspension of the construction of the port of Anaklia, which raises questions in the partnership. This project should not be considered only from an economic point of view but was a test of how ready Georgia is to play its role in strengthening the security of the Black Sea. Unfortunately, Georgia

failed this test and could not choose the right path. Probably, because of the Russian factor, Georgia refused very important opportunities.

The recent state of war opens up a new window of opportunity. After the Karabakh war, the West actually saw the danger of losing the region, as Russia further strengthened its influence in the region, and Georgia remained the only hope to protect Western interests and values (Margvelashvili, Z. 2019).

Russia's interest in establishing control over the Black Sea is important in several directions, including:

- Access to "overseas" or “innersea” conflicts and spaces

The importance of the Black Sea has increased along with Russia's military actions in the Middle East and Africa. The Kremlin uses the sea to support its own activities, which includes using ports in the Black Sea (including Crimea) to supply Russian forces involved in conflicts beyond the sea.

- Confrontation with NATO

The presence and strengthening of NATO members at sea are against Russia's interests. Currently, three NATO countries are represented on the Black Sea, including Romania, Bulgaria, and Turkey. The first two are less capable of counterbalancing Russia's influence, the only one that has more or less this ability is Turkey, although it, despite being a member of NATO, has often been inclined to take an agreed position with Russia, rather than contribute to the strengthening of NATO's forces at sea.

- The Black Sea as part of the Russian space

Russia's actions clearly show its desire to control the Black Sea on its own. If we recall the Cold War period, only Turkey was a member of NATO, the rest were either Warsaw Pact countries (Romania, Bulgaria), or the Soviet Union. Practically, the largest part was controlled by Russia. Today's goal to regain control of the sea has not changed (Stronski, P. 2021).

In the political arena of the modern period, relations between states and their effective development are important and noteworthy. In particular, several factors affect everything mentioned in a complex way - geographical area, historical development, neighboring countries, etc. But attention should also be focused on the leading subjects of the state's policy and their attitude. Yes, the leader is the most important factor in relations between states, of course, along with other factors as well.

Istanbul Canal and Montreux Convention

In 2021, more than a hundred ex-servicemen signed a public statement criticizing the government's plan to withdraw the Istanbul Canal. According to the servicemen, this project was against the interests of Turkey - by taking out the canal, the Montreux Convention might be violated and the situation in the Black Sea region would become tense. The Turkish government was very

strict about the situation, arresting some of the signatories for trying to interfere in the affairs of the democratically elected government.

Of course, Turkey will try to change the Montreux Convention in such a way that neither Russia nor the West will be able to gain control over it in the region. It is possible that the Istanbul canal, at least on a small level, will indeed become a lever to stop Russian influence in the region.

If at the beginning of the 21st century, the Black Sea received relatively less attention from the West, after the 2008 Russia-Georgia conflict, the illegal annexation of Crimea by Russia in 2014, and the ongoing Russia-Ukraine war, the situation has changed dramatically: Domination of the Black Sea has become one of the main components of the conflict between Russia and the West, which has a very valuable geostrategic value for both parties (Tsikarishvili, G. 2021).

Black Sea - the end of Russian hegemony

After the collapse of the Soviet Union, Russia strongly believed that it would retain full control over the Black Sea. However, over time it turned out that Russia did not have enough political and economic power to fully implement its goals. A clear example of this is the so-called color revolutions (the 2004-2005 Rose Revolution in Georgia and the 2004-2005 Orange Revolution in Ukraine), which were previously led by strongly pro-Russian leaders, and after the revolutions, power was seized by pro-Western forces. In the same period, Bulgaria and Romania joined NATO, as a result, 3 (Turkey, Bulgaria, and Romania) of the 6 countries bordering the Black Sea became NATO members, and 2 (Georgia and Ukraine) became NATO partner countries.

It was these events that became the main factor of Russia's irritation, after which the Kremlin began to pursue a particularly rigid regional policy. This was manifested in the large-scale military operation launched against Georgia, which was close to granting the MAP in 2008, as a result of which Tbilisi lost control over the Tskhinvali region.

For Russia, the Black Sea is a platform from which it will conduct destabilizing operations in the Middle East and North Africa. Domination of the Black Sea allowed the Kremlin to launch support operations in the Eastern Mediterranean. It should be noted that with the help of the Black Sea Fleet present in Crimea, Russia was able to provide military and humanitarian operations in Syria in support of the Assad regime.

NATOs strategy and interests in the Black Sea

Although the Euro-Atlantic Alliance has had partners in the region for a very long time, NATO's main interest in the Black Sea region began only after seeing a real threat in the form of the annexation of Crimea from Russia.

However, even in this case, the alliance considered the Baltic Sea as a priority over the Black Sea, which was affirmed by the deployment of reinforced units in Estonia, Latvia, and Lithuania to stop Russian aggression.

It is interesting that Romania and Bulgaria are active in the issue of giving geopolitical importance to the Black Sea. They are members of NATO and the European Union and are actively trying to establish close relations with the USA. That is why Romania especially supports the US in strengthening its position in the Black Sea region, which is joined by countries like Ukraine, Bulgaria, and Georgia. With this, Romania is trying to become the main representative of the European Union in the Black Sea security issue.

Despite the efforts of NATO and its allies, the Kremlin continues to act threateningly and is likely to continue until the West makes a clear decision to restore the balance of power in the Black Sea region, which should end with the accession of such Black Sea countries that have clearly stated their political course to the North Atlantic Alliance. Concludingly, the stated above will be the main motive of the multifaceted economic and political opportunities of the Black Sea.

The geopolitical springboard of the Black Sea unites the most complex and tense regions, it is the crossroads of European and Asian cultures, where the area of redistribution of influence arose. A political leader is a figure on whose correct diplomacy a lot depends, and it was the mistakes made by them in the past that led this part of Eurasia to a hot conflict zone today. In many cases, an idea can be created that the geopolitical situation of the Black Sea is dominated by a single, subjective influence, for which all those internationally recognized values, which have become the constitutionally recognized value of the individual state since the second half of the twentieth century, are equal to zero (Abramidze. T. 2021).

Thus, today, the stability of the geopolitical situation of the Black Sea, together with all the above-mentioned issues, is important to be developed by the political elite and leaders of the respective country:

- Correct political course;
- Internal political stability of the country;
- Effective foreign policy.

These are the three main directions, the effective development of which depends on the proper integration of Georgia, and European progress, which is a guarantee of peace and security. Directing these three main directions is the prerogative of the political leader and it depends on his wisdom and ability to properly implement it.

Conclusion

For effective action in the face of challenges and new opportunities, the Black Sea region needs a comprehensive approach and close cooperation

between NATO and the EU in political, military, and economic directions. Such a strategy should take into account the achievements of the Black Sea countries on the path of European and Euro-Atlantic integration, and also ensure greater involvement in the conflict resolution process while building regional partnership capacities and supporting regional and global projects.

Based on the above, it is possible to make a logical conclusion that, over time, the Black Sea region will become more and more dynamic and more important in terms of regional and international security and further economic growth and development in the region.

Georgia should continue to contribute to the security and stability of the Black Sea region, in accordance with a balanced and pragmatic approach. Despite the above, in today's interdependent world, it would be more and more difficult for a small and vulnerable country like Georgia to protect its legitimate interests without strong partners and allies. Accordingly, the path of European and Euro-Atlantic integration, along with peaceful de-occupation and conflict resolution, with the active involvement of the international community, has no alternative for Georgia. Therefore, full membership in NATO and the European Union will be the most appropriate response to the country's political and economic challenges.

For the security of the Black Sea, it is necessary to create a common command of the Black Sea. NATO's current defense and rapid response strategy cannot respond to the security challenges of the Black Sea, which is why it is necessary to create a new joint command in relation to the Black Sea.

Due to the fact that today most of the military activities in Europe are carried out in the Black Sea region, I think that it is necessary to create a joint command of the Black Sea, which will combine land, sea, and air components.

It is clear that, in addition to the Black Sea countries, other countries also participate in the said command. Forces, capabilities, and bases should be redistributed on the perimeter of the Black Sea in order to control the Black Sea water area.

Unfortunately, in the 21st century we have to contend with a country with a 19th-century mentality, and delaying action gives a hand to a potential adversary, so immediate action is needed. More NATO in the Black Sea is a guarantee for the security of the Black Sea.

References:

1. Margvelashvili, Z. (2019) Security in the Black Sea region. Pp. 3-7
2. Chitaladze, A. (2017) Black Sea Regional Security: New Opportunities for Cooperation on the Road to Confrontation. Pub: Georgian Political Institute. Pp. 3-25
3. Stronski, P. (2021) Russia and Black Sea. Carnegie endowment for the international peace. Available at:

https://carnegieendowment.org/2021/05/20/what-is-russia-doing-in-black-sea-pub-84549 (Last check: 02.08.2022)
4. Tsikarishvili, G. (2021) Geopolitics of the Black Sea and the Istanbul Canal. Pp. 48-67
5. Abramidze, T. (2022) The issue of the Black Sea Straits in the foreign policy of the leading. Pp. 125-153

Conference Proceedings

Immediate Loading of Dental Implants with Fixed Prosthodontic Constructions- Advantages and Methods

Tamar Dolidze, Professor
Adjunct Professor of Grigol Robakidze University;
Associate Professor of BSMA/PI
Marika Kublashvili, Professor
Grigol Robakidze University, School of Medicine, Georgia

Submitted: 13 September 2022
Accepted: 05 November 2022
Published: 30 December 2022

Cite As:
Dolidze T. & Kublashvili M.(2022). *Immediate Loading of Dental Implants with Fixed Prosthodontic Constructions- Advantages and Methods.* European Scientific Journal, ESJ.

Abstract

"Immediate loading of implants" implies loading of implants after extraction of a tooth. The goal of our study was to observe the loss of keratinized gums and bone tissue in the region surrounding the alveolar ridge after tooth extraction, and to compare it to the immediate loading of dental implants with the same indicator. Recently, immediate implant placement after the extraction of a tooth with early loading has become more common. The advantages of this procedure include fewer surgical interventions, reduction in overall treatment time, reduced soft and hard tissue loss, and psychological satisfaction for the patient. This study shows the advantages and methods for immediate implant placement with immediate provisional restorations.

Keywords: Keratinized gum, Immediate loading of implants, alveolar ridge, repeated augmentation, xenograft

Introduction

The cause of bone and/or soft tissue loss after an extraction can be:

1. Anatomical Characteristics

Anatomically, in the alveolar ridge region, we have a bilateral vestibule-oral cortical plate, supporting alveolar bone and plastic alveolar bone (inner cortical plate "Lamina Dura"). The latter is the result of the

concavity of the outer cortical plate, which enters the alveolar part and surrounds the root. Lamina dura is well visualized during radiological research as a thin cortical radiopaque contour located between the periodontal fissure and the cancellous bone. The lamina dura receives nutrition from the periodontium and is connected to the root cement by Sharpay fibers. After tooth extraction, the bone is resorbed and only the surrounding, or supporting, bone remains.

The degree and intensity of alveolar ridge remodeling after extraction depends on many factors. The most important of them are the anatomical characteristics, that must be considered during tooth extraction, especially in the frontal area:

1) Positioning of the tooth root in the alveolar cavity. When the thickness of the vestibular wall is less than 1 mm in the frontal area, more than 2/3 of the root length is resorbed. The greater the volume of supporting bone on the vestibular side, less is the less bone loss. "MA. Atieh, NHM. Alsabeeha, AGT. Payne, S. Ali, CM Jr Faggion, M Esposito. (2021)"
2) Alveolar ridge width. In the case of a thin alveolar ridge, even a slight loss of bone volume may render the implantation impossible. The alveolar ridge is mainly resorbed in a horizontal direction from the vestibular side. The vertical dimensions change slightly during the first 6 months and the ridge takes the shape of a triangle.

To prevent the resorption of the alveolar ridge, the method of preservation of the socket after a tooth extraction during which a bone graft is inserted into the socket, is quite relevant in recent years, to preserve the bone parameters. Loading of dental implants is performed 6 months after augmentation.

Studies confirmed that the difference in bone loss between the control and test groups during preservation was 1.83 mm. "G. Avilo-Ortiz, S. Elangovan, K.W.O. Kramer, D. Blanchette, D.V. Dawson (2014.)" Bone resorption is inevitable after tooth extraction, but the loss is relatively less in the case of conservation. This result is especially important when we have a narrow alveolar ridge.

The studies also found that after preservation of the tooth socket, repeated augmentation during implantation was required in 7% of cases, while in the control group, where no preservation was performed at all, augmentation was required in 42% of cases. Accordingly, it turns out that in the case of preservation we need augmentation in 107%, and without it in 42%. "Barone a. Ricci M. Tonelli S. Santini S, Covani U (2013)"

Based on the above, none of the augmentation methods can fully compensate for the resorption of the alveolar ridge. Moreover, implantation is possible no less than 6 months after preservation. During this period,

especially in the lower jaw, significant atrophic processes take place in the mucous membrane. The height of the attached gingiva and the degree of keratinization in the area of the alveolar ridge decrease. In addition, after 6 months of waiting, it is often necessary to wait another 3-4 months before osseointegration of the implant, which further increases the loss of both bone tissue and soft tissue. "MA. Atieh, NHM. Alsabeeha, AGT. Payne, S. Ali, CM Jr Faggion, M Esposito. (2021)", "Barone a. Ricci M. Tonelli S. Santini S, Covani U (2013)"

The time factor is often a big obstacle for patients and doctors themselves, especially in the field of medical tourism, when the maximum result must be achieved in the minimum time.

Considering the period that has passed since the extraction, the following methods of implantation will be selected. Based on the above table, the most difficulties and expected risks are associated with immediate implantation.

However, due to world globalization, which has led to the acceleration of processes, doctors have to offer the patient to complete the treatment in the shortest possible time. Therefore, immediate implantation has become very relevant.

The method of immediate implantation is not universal, just like any other method of treatment, although in specific cases where there are indications for its use, this method is truly irreplaceable.

The general and local indications of immediate implantation are basically the same as those of classical-gold-standard implantation. An essential requirement is the presence of sufficient supporting bone in the periapical space of the socket in order to achieve sufficient primary fixation of the implant.

Contraindications for immediate implantation are:

1. Presence of acute inflammatory processes in the tissues around the root.
2. Significant destruction of bone tissue around the root.
3. Molars with joined roots.
4. Low position of the maxillary sinus base, when the distance between the apex of the root and the sinus base is less than 4 mm.
5. Close the location of the mandibular canal to the apex of the root.

To carry out immediate implantation, first, it is necessary to make the extraction as safe as possible: (figure1,2,3) not to damage the walls of the socket and the inter-root septum (if it exists). In the case of multi-rooted teeth, root separation is necessary.

During immediate implantation, the protocol for the formation of the implant socket is different and much more difficult compared to classical

implantation. Here we do not have a cortical bone in the alveolar ridge area, so the initial fixation of an implant becomes difficult. In many cases, initial stabilization is simulated -- we may get enough "Torg", but the implant-to-bone contact coefficient (IBC) is quite low, which is the main determinant of osseointegration. Therefore, when the degree of primary fixation of the implant and the IBC coefficient is low, the implant should be closed with a healing screw or a former.

Figure 1 (condition before extraction of the teeth)

Figure 2 (after extraction of the teeth)

Figure 3 (Immediate Loading of Dental Implants X-ray)

The positioning of the implant, especially in the frontal area, is always done in the direction of the palate. (figure 4,5)

In all cases, the gap between the implant and the socket wall is filled with xenograft, packed with a membrane, and sutured into a cavity.

Based on the above, immediate loading of implants has several advantages compared to other methods:

1. More results in minimal time.
2. Relatively low cost.
3. Maintaining the vertical and horizontal parameters of the bone.
4. Keratinized mucosa is maintained.

The results and aim of the research

The aim of our study was to study the degree of bone and soft tissue remodeling in the alveolar ridge area during immediate implantation with bone augmentation. We used implants of different brands and Xeno bone of different brands. To obtain a perfect result, immediate implantation should be accompanied by a temporary prosthesis, (figure6) however, it is not always feasible to perform immediate implantation, and in some clinical situations, the usage of non-removable temporary dentures is impossible. **“**Journal of Prosthodontics. Volume 17, Issue 7, (October 2008), Pages 576-581”.

Advantages of temporary dentures:

- Aesthetics.
- Preparation of prosthetic gown, formation of soft tissues.
- Reducing the probability of infection spreading in the implanted area,
- Adaptation to an artificial crown.
- Time savings for the fabrication of a permanent construct after the osseointegration period.

The decision about the possibility of non-removable temporary construction is mostly made by the implantologist. If satisfactory initial fixation is achieved, fixation of an artificial construction is allowed.

Figure 4 (Before Immediate Loading of Dental Implant)

Figure 5 (X-ray After Immediate Loading)

Figure 6 (Temporary Restoration)

There exist direct and indirect prosthetics.

1. In the case of direct prosthetics, the crown is made on a temporary abutment in the clinic and immediately placed in the oral cavity, while in the case of indirect prosthetics, we take an impression, and the construction is made in the technical laboratory. The maximum time of its fixation should be 72 hours. "Natl J Maxillofac Surg. (2015 Jul-Dec)"

In case of impossibility of non-removable construction during immediate implantation, there are other prosthodontic alternative constructions:

- Removable prostheses.
- Maryland Bridge Prosthesis (adhesive bridge prostheses)

Conclusion

According to our results, immediate loading of dental implants is a method where there's the least amount of loss of marginal bone and gingival keratinization in the alveolar ridge area. Thus, this method does not have an alternative when the necessary conditions for its success are met, and the immediate fixation of prosthodontic constructions makes dental implantation surgery even more successful.

References:

1. Barone a. Ricci M. Tonelli S. Santini S, Covani U (2013) J periodontal 24;1231-1237. "Tissue changes of extraction sockets in humans: a comparison of spontaneous healing vs ridge preservation with secondary soft tissue healing".
2. G. Avilo-Ortiz, S. Elangovan, K.W.O. Kramer, D. Blanchette, D.V. Dawson. Department of periodontics The University of Lowa 2014.
3. "Effect of alveolar ridge preservation after tooth extraction: A systematic review and meta-analysis".
4. Journal of Prosthodontics'. Volume 17, Issue 7, October 2008, Pages 576-581
5. MA. Atieh, NHM. Alsabeeha, AGT. Payne, S. Ali, CM Jr Faggion, M Esposito. "Interventions for replacing missing teeth: alveolar ridge preservation techniques for dental implant site development." Cochrane database of systematic reviews 2021, issue 4, art No CD010176.
6. Natl J Maxillofac Surg. 2015 Jul-Dec; 6(2): 252–255.doi: 10.4103/0975-5959.183864.
7. T. Thalmair, S. Fickl, D. Schneider, M. Himze, H. Wachtel, "Dimensional alterations of extraction sites after different alveolar ridge preservation techniques- a volumetric study" 2013.

8. V. Chappuis, O. Engel, M. Reyes, K. Shahim, L.P. Nolte, D. Buser. JDR Clinical Research Supplement, 2013.
9. "Rigje Alterations Post-extraction in the Esthetic zone: A 3D analysis with CBCT".

Conference Proceedings

The Importance of Integrating Effective Teaching Methods in Business English Classroom

Tamar Dolidze, PhD
Adjunct Professor of Grigol Robakidze University;
Associate Professor of BSMA/PI
Anna Abesadze, MA, Lecturer
Adviser to the Rector of Grigol Robakidze University, Georgia
Brandon Harding
U.S. Fulbright Georgia ETA, Grigol Robakidze University, Georgia
Paola Clara Leotta, PhD
Associate Professor of English Linguistics, University of Catania, Italy

Submitted: 13 September 2022
Accepted: 30 December 2022
Published: 30 December 2022

Cite As:
Dolidze T., Abesadze A., Harding B. & Leotta P.C. 2022. *The Importance of Integrating Effective Teaching Methods in Business English Classroom*. European Scientific Journal, ESJ.

Abstract

The paper highlights the importance of integrating effective methods in teaching English for Specific Purposes, in particular Business English. According to the survey, which includes the contribution from 48 BE instructors worldwide, the article demonstrates the significance of lexical approach, task-based and project-based learning by evaluating the outcomes of integrating them in teaching practice and beyond. The results once again confirmed the hypothesis that task-based learning, lexical approach and project-based learning are the most effective teaching methods in BE classroom. The survey consisted of both open and close-ended questions and aimed at voicing the opinion of BE Course Instructors globally. The target audience was exposed to the above-mentioned teaching methods. At the same time, the survey provides recommendations for novice BE Lecturers on how to ensure maximal approximation to the authentic environment via practicing most useful teaching methods and making the learning process more result-driven, engaging and enjoyable.

Keywords: Teaching methods, Business English, Lexical approach, Task-

based learning, Project-based learning

Introduction

It goes without saying that economic globalization expanded the need for Business English teaching.

All the leading global organizations like the United Nations, World Bank, Commonwealth of Nations, etc. use English as their primary language of choice. This, once again, emphasizes the importance of the English language as a lingua franca not to reflect the diversity represented in the membership. Since these organizations use English as their vehicular language to discuss various world problems, it would be logical to believe that English is not only the present, but also the future of world communication.

Nowadays, every professional, who is eager to succeed, needs to possess Business English skills, regardless of their occupation. Therefore, teaching this subject to learners effectively is vital. In this rapidly changing world, it is impossible to stay on top of the latest developments in different industries without access to the Internet and information which is mostly in English.

All things considered, there is a rising demand for Business English teaching; therefore, it is highly relevant and important to investigate the best possible methods and approaches for Business English classes.

Business English learners vary from young to adult of no age limit. Adult learners know exactly what they want from the course and come with high expectations, deadlines, pre-determined goals and tend to be more self-directed, committed, goal-oriented, and focused with established learning styles.

It is great to have motivated learners that are eager to learn; however, it comes with its challenges for the teacher of English to children. Different from children, adult learners are more detail-oriented and expect high professionalism from their teacher. Business English teachers should understand both the rewarding and challenging nature of the teaching process. Therefore, teachers need to come up with the best teaching approaches and stick to the most effective teaching methods to make their classes inspiring, enjoyable and most importantly, result-driven.

Literature Review

English as a lingua franca (ELF) has increasingly been a subject of interest for Applied Linguistics over the last 20 years or so. How ELF facilitates intercultural communication is closely related to today's global communication. There are indications in English demographic trends that "the constant movement of people across the world has led to the usage of English for intercultural communication" (Graddol 2006). Thus, the view that "today's

ideal speaker lives in a heterogeneous society (stratified along increasingly globalized lines) and has to negotiate with different people representing all sorts of power" (Mufwene 2007: 63) is validated. English speakers in multilingual and multicultural environments have to communicate with other speakers from a variety of language and culture origins, who speak the language more or less proficiently. Should the English used in such situations be that of its native speakers or that of non-native speakers? Moreover, this status of English as the lingua franca of our time poses relevant implications for English language teaching (ELT) and learning.

When we talk about the importance of English in international surroundings, we should bear in mind the recent emergence of BELF - Business English as Lingua Franca. Susanne Ehrenreich (2010) highlights the similarity between English as Lingua Franca (ELF) and BELF as both of them are used by non-native speakers of English during interpersonal interactions. At the same time, the authors note that the main distinction of BELF from ELF is 'Business.' Business ELF is characterized by the following features: its domain of usage, i.e. global business; the role of its users (business professionals) and the overall goal of the interactions held in ELF (getting the job done, or business as usual). All these characteristics are closely linked with the expertise in the field of business, be it any type of business, i.e. academic, international, medical, media, maritime or in general business in which it bridges any gap of miscommunication; and moreover it contributes to effective communication for business via English as the most powerful tool of communication among professionals on the globe. In fact, it is of utmost importance for professionals of any field to be equipped with proper knowledge of business combined with BELF as a means of global communication with multicultural competence.

As we already saw from the importance of professional competence of BELF, we need to integrate BELF in our teaching curriculum, as the graduates of Higher Educational institutions are naturally supposed to be using BELF when communicating for business, be it academic or general business. With this purpose, Grigol Robakidze University as well other HEIS in Georgia and abroad (for instance Italy) offers students both compulsory courses in general English, and optional classes in Business English.

With this in mind, when teaching Business English which is supposed to be ESP, i.e. considering teaching English with the subject matter, it is of paramount importance to engage the learners in efficient and effective communicative activities during all lesson stages and beyond the classroom. What do we mean by effective communicative activities? How can they be effectively integrated when teaching Business English? Which methods can be used in Business English Classroom to support second language acquisition in tandem with the subject? What EFL methods can best suit BELF learners

and teachers' expectations? Which methods should be selected out of already existing ready-made methods offered by the course books? Would it help to go beyond the course books and try to utilize real-life situations and simulations in our BELF classroom?

These are the research questions, which we intend to answer after presenting modern EFL teaching methods, characterizing their advantages and disadvantages for achieving specific goals in BE classroom, surveying students and instructors of Business English participating in virtual exchange Business English Class during Spring Term 2022 at Grigol Robakidze University and Azerbaijan Pedagogical Universities. The aim of the above-mentioned virtual learning experience was to engage teachers of Business English from Georgia and Azerbaijan and other fellow instructors together with their students into meaningful and real-life interaction by using BELF. The methods used in this research will be presented below together with the activities provided at each series of lessons after which the findings of the survey distributed among the above-mentioned groups will be analyzed to highlight the importance of integrating effective teaching methods, i.e. TBL, Lexical Approach, etc., in Business English classroom and provide further recommendations for continued application in face-to-face classroom.

Task-Based Learning (TBL)

Since it is preferred to utilize authentic materials in teaching business English, the Task-Based approach is one of the top methods to use in teaching Business Students. What is Task-based learning and what are the benefits of using it in Business English?

Task-based learning, which involves student-to-student interaction, means working in small groups to perform particular tasks. The activity guided by the teacher involves all four skills. For example, this might include sales campaigns, making a phone call to make a reservation, making a short movie, making an advertisement, visiting a doctor, etc.

The main advantage of this approach lies in its ability to prepare students for real world and genuine communication. Participants develop language flexibility needed at the workplace, that is new if compared to the use of pre-taught materials. They are "forced" to brainstorm their knowledge in their respective fields and imagine themselves as if they were at work and performing tasks with their colleagues. This activity already provides a purpose for the language usage and focuses students' efforts on the needed area which makes the language acquisition process not only more effective, but also more enjoyable. After all, the basic aim of a task is not only to communicate, but to accomplish the outcome while focusing first and foremost on pragmatic meaning. (Ahmed & Bidin, 2016) TBL also asserts that the language is best acquired when the focus is on meaning instead of

grammatical structure, as language is a highly interpersonal enterprise. (Ahmed & Bidin, 2016) The form vs. meaning debate is an ongoing debate; but if we consider the student-centered nature that is a priority for Business English class, then we can obviously admit the advantage of "meaning-based" focus. Even though TBL focuses on acquiring language through constructive communication, interactions and negotiation, it also allows students to practice grammar via using authentic language. (Richards & Schmidt, 2010). Of course, TBL has its flaws. It is hard to motivate students to take the task seriously and be actively engaged in the learning process of each stage. However, this can be overcome by the teacher's ability to raise students' curiosity and establish credibility. TBL is itself an answer to this disadvantage, as following on "the Expectancy-Value Theory" on motivation, people are motivated to perform things that they perceive to have a value and at which they are prone to succeed (Richards & Schmidt, 2010). TBL activities are connected with students' chosen fields; therefore, they should be more inspired to perform them. Furthermore, experiential learning vs. academic one is argued to improve motivation and awareness of language skills in addition to providing support to develop essential language ability (Richards & Schmidt, 2010).

To conclude, we could consider TBL as one of the most effective approaches in teaching Business English. Richardson and Schmidt sum up this advantage in a sentence: "TBL is a more effective way of learning a language since it provides a purpose for the use and learning of a language other than simply learning language items for their own sake." (Richards & Schmidt, 2010) Hence, TBL is an ideal fit for the student-centered, result-driven nature of Business English Classroom.

Lexical approach

The lexical approach is a unique teaching method that is based on the idea that language is made up of lexical units or "chunks" rather than standard grammatical structure. These chunks are formed by fixed phrases or words that have a habitual juxtaposition between each other. This was a method developed in 1993 by the linguist Michael Lewis in his ~~written~~ work titled "The Lexical Approach: The State of ELT and a Way Forward". The concept is that, rather than having students memorize vocabulary lists, they would analyze useful phrases. It is primarily based on the idea that certain words will trigger a reaction to a particular set of words. In doing so, students would be able to understand which words share a connection. Students are expected to learn the grammar structure through the recognition of the patterns of the words. Lewis states that "The Lexical Approach implies a decreased role for sentence grammar, at least until post-intermediate levels. In contrast, it

involves an increased role for word grammar (collocation and cognates) and text grammar (suprasentential features)" (Lewis, 1993: 3).

Lexical approach provides many benefits while implementing it in Business English courses. The lexical approach speeds up language acquisition. The use of "chunking" is actually a technique that helps enhance one's memory and receptive skills in grammar (Coady & Huckin, 2012). As mentioned before, by assembling a common set of words and treating them as one larger whole, the brain is allowed to process greater amounts of information. The method of chunking makes it easier to teach a wide range of information quickly. The nature of the lexical approach is communicative and reflects how native speakers actually communicate among themselves. Using this approach would lead to better results when it comes to students sounding natural and fluent.

The lexical approach also has a practical usage that can be applied in real world situations. Students get fixed phrases and expressions that can be used in daily conversations with native speakers. In the case of Business English, this works well for the many that will work in a professional setting later in life. Constant practice of the use of these phrases prepares the students to naturally engage and respond to others in an English speaking workplace.

Lexical Approach also addresses the problem of how we successfully get students to memorize the large number of terms, idioms and phrases within the subject of Business English and of English for Specific Purposes in general. This problem can be resolved with the help of the Lexical Approach. It focuses on language functioning, how we learn and remember it, and how we use it. The main idea of the approach is to show how grammar and vocabulary interact through multiple representations in different contexts (Rubtsova, 2020). Using a lexical approach allows us to focus on grammar structure and vocabulary that really count so they don't feel overwhelmed by the plethora of terms in Business English.

Project- Based Learning

Similar to that of Tasked-Based Learning, Project-Based Learning is another active learning teaching method that raises students' awareness through the explorations of real-world scenarios and challenges. It's a teaching method in which students engage in a project for an extended period of time to critically assess and solve authentic complex questions, challenges, and problems. Project based learning differs from an ordinary project because it makes the project the unit of the course, rather than being a short project for a teaching unit. It can be considered as a versatile vehicle for fully integrated language and content learning (Beckett & Miller, 2006). This also allows room for diversity within the activities, since students get the opportunity to share

their culture, interest, and thought with each other. With that being said, PBL offers many advantages when teaching courses such as Business English.

Similar to Task-based learning, project-based learning helps prepare students for professional workplaces. These project activities allow them to hone their skills in project planning, decision making, team building, and time management. It increases motivation and productivity within the classroom. PBL has the capacity to keep students interested and motivated while they are learning due to its context-driven nature, versatility, and practicality. These conditions are necessary ingredients for success in EFL and ESL teaching and learning processes (Velásquez, 2012). PBL connects learning with reality as students retain more knowledge and skills when they are engaged in stimulating projects. Unlike traditional teaching methods where students are taught to memorize facts word for word, these project activities utilize real world situations allowing students to harness their creative thinking skills. The result will lead to students reacting and speaking more naturally in the language. In addition, project-based learning provides collaborative opportunities to construct knowledge. Collaborative learning allows students to bounce ideas off each other, voice their own opinions, and negotiate solutions, all skills that will be necessary in the workplace (Velásquez, 2012). The downside of Project-based learning is that it can be time consuming. The teacher must be prepared to use a significant amount of time to thoughtfully plan out a project idea that will be effective for the students. Another disadvantage is that PBL can be quite intimidating for some teachers as it is more student-centered rather than teacher-centered. The teacher's role is to pose the driving questions and to facilitate each phase of the project while the students are the ones in direct control of how they would want to approach the topic. Teachers might be afraid that students will struggle to keep up to pace with each phase or it might be unbalanced, because some students might have a lack of knowledge on the present task. To resolve this issue, teachers need to remember to actively monitor students' performance through each step and stimulate discussions when possible. As they feel more comfortable by themselves, students will realize that PBL is teaching skills in self-assessment and responsibility of their own learning.

It is of particular importance to analyze and highlight the responses on the open-ended questions, which evidently showed an interesting approach of Business English instructors in Georgia, Azerbaijan and other countries.

Survey

To highlight the importance of integrating effective teaching strategies in the Business English classroom, a mixed type of survey was developed, consisting of close and open-ended questions. The survey was distributed in an online form among BE instructors from different countries, starting from

the teachers initially involved in virtual exchange classes from Grigol Robakidze University and Azerbaijan Pedagogical University, who have delivered virtual classes to Georgian and Azerbaijani students during Spring 2022. Other respondents were Business English Instructors invited via IATEFL BESIG, Partner HEI of GRUNI in Italy, the University of Catania, as well as other social and personal professional networks. The link of the survey is as follows:
https://docs.google.com/forms/d/e/1FAIpQLSfPKMvlOVi2Fj4Oe0p4c0f0TmGLDlxpzPLv6DVB_4DcskIlVA/viewform?usp=sf_link

Discussion of Survey results

The total number of respondents was 48. As mentioned above, the survey was filled out by Business English Instructors from the following countries: Georgia, Azerbaijan, US, Canada, Greece, Italy, Poland, Scotland, Turkey, Ukrainee and France.

The majority of the surveyed ones (74.4%) strongly agreed with the statement that Business English is a key to career success for the professionals of all areas. This means that emergence of BELF is indeed supported with the findings of a small-scale survey. The majority of the respondents (25%) strongly agreed, whereas 29.2% agreed with the statement that Business English must be a compulsory subject in higher education, which shows its growing demand in the corporate surrounding as well as among the students and instructors of higher educational institutions in a number of countries covered with the survey.

An absolute majority of BE teachers (39.3%) strongly agree and 43.7% agree with the statement that Business English can be found difficult to teach without maximal approximation to authenticity, which at the same time supports the idea of integrating authentic materials while teaching Business English with the effective methods and teaching strategies reviewed in this article. Therefore, we should remember that authenticity can be best achieved with properly selected methods and strategies. Hence, on the statement 'Effective teaching methods should focus on developing both receptive (reading/listening) and productive (speaking/writing) skills in the classroom - an absolutely majority of the respondents (74/5%) strongly agreed, whereas 21.3% agreed, which highlights the importance of boosting both skills, i.e. receptive and productive in the process of second language acquisition.

An absolute majority of the respondents (75%) strongly agreed, whereas 16.7% agreed with the next statement - Selecting right teaching methods is essential for achieving specific goals of a Business English classroom, which once again demonstrates the need for making a reasonable decision when selecting proper teaching methods in a Business English classroom.

It was interesting to analyze the results of BE instructors on the role of different teaching methods, i.e. Lexical Approaches, Task-Based Learning and Project-Based learning in Business English Classroom. 35.4% of the respondents agreed and 50 % strongly agreed with the statement that Lexical Approach should be used as one of the key methods when teaching subject-relevant vocabulary in BE classroom, which shows primary function of integrating LW into business English classroom to deal with special terminology characteristic for the field.

45.8% of the respondents strongly agreed and 50 % agreed with the statement that - Task Based Learning (TBL) should be used as one of the key methods for boosting productive/receptive skills in BE classroom which is more than understandable due to the advantages listed in the literature review of the latter method and once again it validates very practical, useful and effective features of TBL for all BE learners.

45.8% of the respondents strongly agreed, 35.4 % agreed and 18.8 % of the surveyed showed a neutral attitude towards the last statement - Project based learning should be used as one of the key methods for boosting productive/receptive skills in the BE classroom. This variety of responses can be justified with the fact that PBL indeed as highlighted in the Literature Review part needs more preparation, experience, and evidently efforts, though worth taking.

On the open-ended question: What are the advantages of Lexical Approach, TBL and PBL from your BE teaching experience - a wide range of responses shows the individual approach of BE teachers towards each method. As we see from the responses, Lexical approach "~~It~~ gives students necessary vocabulary, TBL helps students to continue learning ESP based on tasks, and PBL is very effective in terms of generating outcomes.'

According to other respondents 'TBL is very useful as it reflects real-life world. Lexical approach also helps us use pre-taught materials and phrases in communication'. One of the respondents even cannot hide admiration towards LA stating that 'lexical approach works wonders as it provides logical connections among words, and learners are very keen on getting information as systematically as possible'. Some of the teachers directly show their preference for this method – 'PBL is the best method for me. It focuses on practices which are taken from real-life situations and which undoubtedly will be useful for students in the future; however, I have applied TBL many times, which has more language focus; and in fact all of them are necessary and timely in teaching Business English'. Though, other teachers also try to display pros and cons of all the above mentioned methods, stating that 'As all teaching methods, Lexical Approach has some advantages and disadvantages. Some advantages from my BE teaching experience are: It encourages the process of noticing the lexical item, allows the brain to process greater

amounts of information, and speeds up language acquisition. In addition, it teaches communication. They break with the grammar translation method'. So, as we see BE teachers admit the advantageous nature of LA in comparison to other methods, as it enables the learner to have access to 'Student-centered lessons; Closeness to authenticity, practicability', which is very important when teaching Business English.

When asked about advantages of each method, one participant expresses her/his inclination towards 'Lexical approach - learning vocabulary and then being able to implement it in some specific professional situations and in a variety of contexts is the starting point of ongoing professional communication. Implementation of TBL and BBL will enable our students to make their future professional communication effective, by being able to implement their knowledge of business vocabulary in the process of problem-solution. Thanks to TBL and BBL, they will be able to concentrate on and solve the whole variety of problems typical for their everyday professional activity' – which is really understandable and well-justified.

Another respondent writes that 'Lexical Approach - speeds up language acquisition. TBL - It is very conducive to group learning. PBL - Encourages student self-assessment of learning. They improve teamwork, collaboration and creative thinking'.

One of the BE teachers uses 'Lexical Approach to teach Reading. I have been teaching for over 30 years and TBL and PBL are the best ways to teach Business English'. According to the same respondent, when teaching BE it is very important to take into account the experience in the field of business or work in Business before teaching. It makes a big difference. So many FAKE Business English teachers out there now'. This shows that being a BE teacher really requires expertise in both language teaching methodology and subject matter.

One of the respondents when commenting on the three methods noted: "*all three allow us to paint a realistic picture of how things work in real business life. As a language coach supporting BE for many clients, I see the more independence and control learners are 'allowed' and the more decisions learners may make, and the more control they have over input and output, the higher motivation and development will be. In combination, they make an unbeatable method of teaching Business English".*

According to another experienced BE teacher, who 'used all three in various degrees during his 25-year career depending on the students he used more TBL and PBL with groups'. According to the same author, LA prioritizes vocabulary and provides a varied focus to help raise students' awareness of how words work; TBL provides meaningful and usually authentic-like practice to help prepare students for the real world and PBL, I rarely use this. They are all result-oriented and provide measurable skills

development. Authentic materials, vocabulary specific to their needs, authentic situations, collaborative skills are strongly developed and motivational because they are truly useful. Terminology teaching is essential because it is linked to credibility in business life. TBL is essential because it is linked to real life tasks. So, as we see the same authors agree on teaching with LA for better acquisition of the special language and TBL for integrating real-life tasks in the BE classroom.

Other respondents state that 'Lexical approach is fundamental both in formal and informal contexts, as it is consciousness raising. TBL helps students use their skills at their current level, developing language through its use. I have no experience of project-based teaching. Better approximation of real usage than TBL & PBL also allow professionals to leverage their real world experience to support language learning. Their common advantages can be considered: learner independence, authenticity and student centeredness; motivation of all stakeholders, relevance and applicability of results'.

Some respondents give the following characterization of teaching methods: 'LA: boosting vocabulary, fluency; TB: hands-on, effective; PB: complex, collaborative. These approaches are student centered'.

All surveyed BE teachers are well acquainted with all three teaching methods, especially LA and TBL and use them regularly in their teaching practices with a variety of reasons well-justified in the responses.

On the final open-ended question - Which of the above-mentioned teaching method(s) was/were most useful and effective in your experience? The following responses were obtained: 'TBL; PBL; All of them'; 'I love using Lexical Approach at the initial stage _ presentation stage of the lesson whereas TBL can be used effectively during practice and production stage. PBL is very effective for longer period tasks', 'lexical approach'. Another BE teacher states 'there's no single way to teach English; and in fact, there have been many popular approaches over the years. Which is the best? It depends on the level of English of your students. By asking questions and solving problems, with the teacher as a mere learning facilitator, student motivation and participation in tasks and projects are thought to increase. So called -an active learning style is best suited for interactive classrooms, which helps the student gain knowledge'.

Others write that 'TBL is one of the most effective methods'.
Others vote for 'Task based and project based teaching'. 'The Lexical approach'; 'PBL'. 'All and each of them'.

For others, 'PBL seems to be the most useful in my experience because it is a self-directed method that allows the student's freedom to be creative yet at the same time prepares them for real-life scenarios'.

'Depends on context and needs analysis'. 'I think TBL and PBL were the most useful and effective methods in my professional life since I have been working at a multinational organization for a long time'.

'TBL and PBL'; 'Lexical Approach with Projects thrown in'. 'PBL and TBL' 'All three in combination'; Project based M'. 'TBL with a big dose of vocab and typical expressions'; 'I mostly use TBL in my classes'; 'LA'. 'all three of them'; TBL, Lexical Approach'; 'Lexical approach, TBL'.

'I use them all in parallel - they work well together. TBL first, then Lexical Approach for input and feedback, and PBL for extended exploration'. 'Lexical approach'.

'A mix according to specific needs of the individuals/groups being taught'. 'TBL and PBL'; 'LA and TB'. 'PB is hard to implement in a corporate environment in the frame of a language course'.

'I believe all of them would be extremely useful'; 'Lexical Approach', 'TBL, Lexical Approach'.

'TBL allows students to be fully immersed in the lexicon of a subject, which boosts confidence in writing and oral skills'.

As seen from the replies provided by 48 respondents, all of them have individual preference when selecting each method, though it is noteworthy that the majority of them show preference towards LA and TBL, though more experienced teachers also vote for PBL. This once again highlights that all of the surveyed BE teachers have made a good usage of them for more effective BE classes in the teaching experience.

Conclusion

It is evident that due to the growing demand for Business English at the watershed of the new millennium, a good mastery of BELF is necessary in order to succeed in workplace communication globally and locally. At the same time, due to a wide range of Business English learners from young students to adult learners of no age limit, it is important for BE instructors to identify the need of each category, seek for most applicable effective teaching methods for this very category, and respond to them in an efficient and timely manner. Some adult learners know exactly what they want from the course and come with high expectations, deadlines, pre-determined goals and tend to be more self-directed, committed, goal-oriented, and focused with established learning styles. Whereas, younger learners, especially teenagers, may not be in the same situation and can afford spending more time being engaged in the activities offered by BE teachers via selecting the most effective teaching methods as discussed above.

Based on the findings of the survey and analyzing the input from BE teachers at GRUNI and Azerbaijan Pedagogical University delivering joint Virtual Classes in BE, as well as more experienced educators of BE from

abroad, we could once again highlight that Business English is a key to career success for the professionals of all areas. At the same time, survey outcomes enabled us, BE teachers, to raise the issue of adding BE among compulsory disciplines due to growing demand for BELF. It is worth mentioning that the survey validated the hypothesis that teaching Business English can be facilitated with maximal approximation to authenticity, i.e. application of real-life examples, case studies, situations and scenarios can definitely contribute to effective acquisition and practice of the target vocabulary by producing practical solutions related to the field of business.

It is very important to remember, as BE teachers, to use a versatility of methods targeting at developing both receptive and productive skills in a business English classroom, which was unanimously supported by an absolute majority of BE teachers. Besides, an absolute majority of respondents strongly agree on the necessity of selecting right teaching methods for achieving specific goals of the Business English classroom, which is also supported with the responses of open-ended questions in the qualitative part of the survey. And finally, BE teachers participating in the survey admit that all the discussed methods - Lexical Approach, Task-Based Learning and Project-Based Learning should be used as key methods when teaching Business English depending on the primary and subsidiary goals of the lessons, i.e., teaching subject-relevant vocabulary, boosting productive/receptive skills in BE classroom.

References:

1. Beckett, G. & Miller, P. (2006). *Project-based second and foreign language Education Past, Present, and Future.* U.S.A: Library of Congress Cataloging- in-publication Data.
2. Coady, J. (1996). L2 vocabulary acquisition: A synthesis of the research. In J. Coady & T. Huckin (Eds.), *Second Language Vocabulary Acquisition: A Rationale for Pedagogy* (Cambridge Applied Linguistics, pp. 273-290). Cambridge: Cambridge University Press. doi:10.1017/CBO9781139524643.020
3. Jack Richards, Richard Schmidt. (2010). *Longman Dictionary of Language Teaching and Applied Linguistics.* Retrieved from Longman Dictionary of Language Teaching and Applied Linguistics
4. Kankaanranta, A. & Lu, W. (2013). The evolution of English as business lingua franca: Signs of convergence in Chinese and Finnish professional communication. *Journal of Business and Technical Communication*, 27(3), 288-307.
5. Lewis, M. (2002). *The Lexical Approach: The State of ELT and a Way Forward (Language Teaching Publications)* (1st ed.). Heinle ELT.

6. Louhiala-Salminen, L. & Kankaanranta, A. (2011). Professional communication in a global business context: The notion of global communicative competence. *IEEE Transactions on Professional Communication*, 54(3), 244-262.
7. Piekkari, R., Welch, D. E. & Welch, L.S. (2014). *Language in international business: The multilingual reality of global business expansion*. Cheltenham, UK: Edward Elgar Publishing.
8. Rai Zahoor Ahmed, Siti Jamilah Bt Bidin. (2016, June 2016). The Effect of Task Based Language Teaching on Writing Skills of EFL Learners in Malaysia. *Open Journal of Modern Linguistics, Vol. 6*(#3), 207-218. doi:http://dx.doi.org/10.4236/ojml.2016.63022
9. Rubtsova, Svetlana. (2020). The Lexical Approach in Teaching English for Economics Online. 181-189. 10.15405/epsbs.2020.12.02.27.
10. Velásquez, T. (2012). "Hybrid Method" An integrated pedagogical method for EFL teaching and learning. *Zona Próxima*, *1657–2416*, 194–211. http://www.redalyc.org/articulo.oa?id=85324721013