Energy Literacy

A report

ON EXISTING ENERGY LITERACY COMPETENCIES BY YOUNG ADULTS IN THE FOLLOWING COUNTRIES:

AUSTRIA, CROATIA, GREECE, POLAND AND SLOVENIA

ENERGY LITERACY-PRACTICAL TRAININGS FOR SUSTAINABLE ENERGY CONSUMPTION VIA PERSONAL BEHAVIOURAL CHANGES

Co-funded by the European Union

POLSKA SIEĆ Energie Citēs

innovation hive

MIITR

REGEA

LEVILO

KSSENA

Co-funded by the European Union

This Project has been funded by Erasmus+ under the action KA220-ADU - Cooperation partnerships in adult education and as described in the project proposal 2021-1-PL01-KA220-ADU-000033582.

Project title: ***Energy literacy–practical trainings for sustainable energy consumption via personal behavioural changes***

Project duration: ***1. 2. 2022 - 31. 1. 2024***

International Institute for the Implementation of Sustainable Development,
Maribor, Slovenia

CONTRIBUTOR

Maribor
June 2022

Designed by MIITR

REPORT EL PRACTICE:
COMPETENCIES QUESTIONNAIRE

This report encompasses the gained results from conducted questionnaires under the Erasmus+ project, ***Energy Literacy Practice,*** which aims to assess the levels of energy literacy among *young adults* with the goal of identification of possible gaps and designing new learning materials based on the analysed responses from this questionnaire and the national state-of-the-art report.

INTRODUCTION:

Energy literacy capacity building is the ability to understand competencies and levels of knowledge, the actual needs of young people.

METHODOLOGY:

The case study has been conducted on the national level of five distinct countries, namely Slovenia, Greece, Austria, Croatia, and Poland, with the additional option of other if the addressed person lived in any other country. A random sample, with the end result of n=219 completed questionnaires obtained for further analysis. The resulting sample had predominantly female participants and a small percentage of male participants (71.1% and 28.9% respectively). The vast majority of participants either owned their own house/apartment (48,4%), followed up by a rented house/apartment, co-living, or other option (30.6%, 18.7% and 2.3% respectively), on top of high education, followed by secondary (83.6% and 16.4% respectively).
The questionnaire consisted firstly of seven general questions, followed by 27 topical questions. The topical questions were based upon a five-point Likert-type scale, ranging from 5 (I completely agree) to 1 (I completely disagree) (Likert, 1967), designed to explore the energy literacy competencies of the participants. The collected statistical data and its further

analysis were conducted with the help of Statistical Package for the Social Sciences (SPSS) version 28.0.

For an in-detailed understanding of gained results, factor analysis has been conducted to identify fundamental variables or factors that explain any correlation patterns within a set of observed variables. For this reason, factor analysis has been chosen, mainly because of its potential of reducing the amount of data, and identification of a small number of factors that in the best way explain the variance over a larger number of created variables (Batagelj, 2010). When conducting the analysis, the principal component analysis (PCA) was used for extraction, mainly because of its practicality and preference (DeCoster, 1998), as seen in the model (Eq. 1):

$$z_1 = a_{11}F_1 + a_{12}F_2 + \ldots + a_{1k}F_k$$

$$z_2 = a_{21}F_1 + a_{22}F_2 + \ldots + a_{2k}F_k \qquad \text{(Eq. 1)}$$

$$-$$

$$z_k = a_{k1}F_1 + a_{k2}F_2 + \ldots + a_{kk}F_k$$

Furthermore, both commonalities and eigenvalues were used to help define key factors, which act as proportions to each variable variance zi can be explained by the principal components, and measure the percentage variance within a given variable, as explained by all the factors jointly, and can be interpreted as the reliability of the indicator, as seen bellow (Bastič, 2006), (Eq. 2):

$$h_i^2 = a_{i1}^2 + a_{i2}^2 + \cdots + a_{im}^2 \qquad \text{(Eq. 2)}$$

Furthermore, both commonalities and eigenvalues were used to help define key factors, which act as proportions to each variable variance zi can be explained by the principal components, and measure the percentage variance within a given variable, as explained by all the factors jointly, and can be interpreted as the reliability of the indicator, as seen bellow (Bastič, 2006), (Eq. 2):

$$\lambda_j = a_{1j}^2 + a_{2j}^2 + \cdots + a_{kj}^2$$

$$\lambda_1 > \lambda_2 > \cdots > \lambda_k \qquad \text{(Eq. 3)}$$

Considering the before-mentioned rules, the minimal eigenvalue that is still valid for good variance results was set to be 1 or more, with variances below this value having little to no effect on the overall end results. The Syntax used for the factor analysis can be seen on Fig. 1.

```
* Encoding: UTF-8.

set tvars both.

FACTOR
  /VARIABLES V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11 V12 V13 V14 V15 V16 V17 V18 V19 V20 V21 V22 V23 V24 V25 V26 V27 V28 V29 V30 V31 V32 V33 V34
  /MISSING PAIRWISE
  /PRINT INITIAL DET KMO CORRELATION EXTRACTION ROTATION
  /FORMAT SORT BLANK (.30)
  /PLOT EIGEN
  /CRITERIA MINEIGEN (1) ITERATE (100)
  /EXTRACTION PC
  /CRITERIA ITERATE (100)
  /ROTATION VARIMAX
  /METHOD=CORRELATION.
```

Fig. 1: A Syntax developed for the factor analysis used to obtained the results.

RESULTS:

A correlation analysis indicated the sense of using the PCA factor analysis. The appropriateness of the factor analysis is examined also by using Bartlett's test of sphericity, which helps to determine whether the correlations among variables are sufficiently high enough to indicate the existence of factors (Meyers et al., 2006), and with the Keiser-Meyer-Olkin (KMO), an index examining the degree of correlation among variables (Meyers et al., 2006), (as shown in Table. 1).

Table 1: Kaiser-Mayer-Olkin and Bartlett's test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,828
Bartlett's Test of Sphericity	Approx. Chi-Square	2935,634
	df	561
	Sig.	,000

If the KMO analysis has a value of 0.6 or higher, then the data are considered appropriate for performing factor analysis (UCLA, 2011). KMO in our case is very high 0.828. The factor analysis relationships can only be performed if the resulting matrix is not an identity matrix. This is calculated using Bartlett's test of sphericity, where if the significance value is less than 0.05 then the matrix is not an identity matrix (Field, 2005). Our results indicated a significance of 0.000, which allows further data processing.

Table 2 indicates the results' communalities, where it can be observed that they are higher than 0.5. This indicates that the variables are significant, and thus none of them can be discarded.

Table 2: Communalities of the variables.

Communalities		
	Initial	Extraction
V1	1,000	,647
V2	1,000	,582
V3	1,000	,674
V4	1,000	,660
V5	1,000	,690
V6	1,000	,574
V7	1,000	,526
V8	1,000	,667
V9	1,000	,687
V10	1,000	,678
V11	1,000	,773
V12	1,000	,691
V13	1,000	,596
V14	1,000	,543
V15	1,000	,635
V16	1,000	,677
V17	1,000	,736
V18	1,000	,647
V19	1,000	,605
V20	1,000	,695
V21	1,000	,413
V22	1,000	,629
V23	1,000	,623
V24	1,000	,583
V25	1,000	,680
V26	1,000	,600
V27	1,000	,648
V28	1,000	,483
V29	1,000	,576
V30	1,000	,699
V31	1,000	,752
V32	1,000	,714
V33	1,000	,602
V34	1,000	,609

Extraction Method: Principal Component Analysis.

Table 3 indicates the total variance explained, where the "total" column contains the eigenvalues. A conventional criterion was used when selecting the principal components, i.e. the selected factors present minimal variance of 60 %. In our case a factor model with 9 factors, accounting for 63,52 % of the data variance. Such distribution is satisfactory, as they include over 2/3 of the total variance and present the overall results in a strong enough way.

Table 3: Total variance explained.

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	7,719	22,702	22,702	7,719	22,702	22,702	3,735	10,985	10,985
2	3,797	11,168	33,869	3,797	11,168	33,869	3,669	10,791	21,776
3	1,891	5,562	39,431	1,891	5,562	39,431	3,457	10,167	31,943
4	1,837	5,402	44,833	1,837	5,402	44,833	2,355	6,928	38,870
5	1,595	4,690	49,523	1,595	4,690	49,523	2,181	6,414	45,285
6	1,419	4,173	53,696	1,419	4,173	53,696	1,871	5,504	50,788
7	1,257	3,697	57,394	1,257	3,697	57,394	1,689	4,968	55,756
8	1,058	3,111	60,505	1,058	3,111	60,505	1,418	4,170	59,926
9	1,026	3,018	63,523	1,026	3,018	63,523	1,223	3,597	63,523
Extraction Method: Principal Component Analysis.									

In order to define a simplified factors' structure a factor rotation matrix have been defined. The modified (rotated) belonging factors' weights (correlations) are presented in Table 4. Correlations with a value of 0.3 or less were discarded since the low correlations were unimportant for further interpretation. Table 4 shows the variables that had high factor weights for the 9 factors selected.

Table 4: Rotated Component Matrix.

Total Variance Explained									
		Initial Eigenvalues		**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
V23	,690								
V30	,676								
V33	,638		,354						
V13	,560		,346						
V20	,530						,497		,337
V8	,498	,351							
V22	,492	,354							
V14	,454		,426						
V21	,394			,358					
V25		,788							
V19		,716							
V24		,670							
V27		,652							
V16		,552			,549				
V15		,525		,310	,480				
V28	,396	,439							
V11			,844						
V12			,814						
V10			,734						
V9			,708						

Table 4: Rotated Component Matrix.

Total Variance Explained

V32			,350	,717					
V31				,691					
V29				,639					
V17					,767				
V18		,450			,609				
V2									
V1	,402					,484			
V7						,337	,595		
V3								,788	
V26									,612
V34							,371		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 20 iterations.

Table 5: Identified and aggregated factors.

Identified factors (F)	Aggregated factors (AF)	Variance explained (in %)
F1: energy efficient behavior F5: education and awareness raising F7: educational background	AF1: education and awareness raising	31,81
F2: EU directives F9: investments in energy efficiency	AF2: investments in energy efficiency	14,17
F6: age F8: gender	AF3: age and gender	7,28
F3: climate change and environmental protection	AF4: climate change and environmental protection	5,56
F4: sustainable lifestyles and social environment	AF5: sustainable lifestyles and social environment	5,40

The results of the SPSS helped us to identify 9 factors that have the highest influence the literacy, and this will help us designing topics within our further project development. A closer analysis of these factors revealed that some of them intersect, whether in content or semantics, e.g. education and educational background, awareness raising. Grouping these factors into five overarching themes allows to better identify and explain competencies gaps, and topics which needs attention during the development of the educational materials, see Table 5. Thus, the emphasis should be given to the following:

- Education and awareness raising
- Investments in energy efficiency
- Age and gender represent factors to improve more energy sustainable behavior
- Climate change and environmental protection
- Sustainable lifestyle and social environment

CONCLUSIONS

Some of the emerged topics are in a line with the proposed topics within the application form. This will however give us and excellent standing point for our further project development.

REFERENCES:

Bastič, M., 2006. Research Methods, University of Maribor, Faculty of Economics and Business, Maribor, Slovenia.

Batagelj, V., 2010. Factor analysis: study material for postgraduate study of Statistics. Faculty of Mathematics and Physics, University of Ljubljana. Available online: http://vlado.fmf.uni-lj.si/vlado/podstat/Mva/FA.pdf (Retrieved 12.07.2022).

DeCoster, J., 1998. Overview of Factor Analysis. Available online: http://www.stathelp.com/notes.html (Retrieved 12.07.2022).

Ferligoj, A., Leskošek, K. & Kogovšek, T., 1995. Measurement reliability and validity, Faculty of Social Sciences, Maribor, Slovenia.

Field, A., 2005. Factor Analysis Using SPSS. Research Methods II: Factor Analysis on SPSS Retrieved from: http://www.statisticshell.com/factor.pdf

Meyers, L.S., Gamst, G., Guarino, A.J., 2006. Applied Multivariate Research, Design and Interpretation. Sage Publication Inc., Thousand Oaks, CA, USA

UCLA, 2011. Principal Component Analysis. Academic Technology Services. University of California, Los Angeles. Available online: http://www.ats.ucla.edu/ stat/SPSS/output/principal_component.htm

ENERGY LITERACY-PRACTICAL TRAININGS FOR SUSTAINABLE ENERGY CONSUMPTION VIA PERSONAL BEHAVIOURAL CHANGES

The Association of Municipalities Polish Network „Energie Cités", *Kraków, Poland*
INNOVATION HIVE, *Larissa, Greece*
International Institute for the Implementation of Sustainable Development, *Maribor, Slovenia*
North-West Croatia Regional Energy Agency, *Zagreb, Croatia*
LEVILO - Association for ecological and social sustainability, *Graz, Austria*
The Energy Agency of Savinjska, Šaleška and Koroška region, *Velenje, Slovenia*

Energy Literacy