ARTÍCULOS

Revista **Complutense de Educación**
ISSN-e: 1988-2793

EDICIONES COMPLUTENSE

https://dx.doi.org/10.5209/rced.77232

Lifelong learning and personal learning environments: a productive symbiosis in higher education[1]

José Antonio García-Martínez[2]; Mercedes González-Sanmamed[3]; Pablo-César Muñoz-Carril[4]

Abstract. INTRODUCTION. The aim of this study was in first place, to validate the lifelong learning (LLL) scale, and for later, to analyze this learning perspective and its relationship with the educational approach of the personal learning environment (PLE). In the last year students do various degrees at a university in Costa Rica. METHOD. Using a non-experimental, transactional design, we applied a probabilistic questionnaire where the representative sample was (n=1187). For the validation, an exploratory factor analysis using the maximum likelihood method with oblimin rotation was carried out. The scope of the study is descriptive and correlational. RESULTS. The results show that the LLL scale used is a valid, and the tool used to explore the topic is reliable. In addition, we saw a moderate inclination towards lifelong learning in the students, mainly about all the application capability of new knowledges and skills in practical surroundings, and how they relate to the new learning with previous acquisitions. DISCUSSION. It is observed a significant relationship among this training approach and personal learning environments, characterized by the use of the potential offered by technological tools. It has been found significant differences by gender, knowledge area, academic performance, and internet connection hours. Among the conclusions, it is pointed out that the universities must foster the linked competences with LLL to boost the PLE of the learners and propitiate its optimum social and professional insertion along their vital route.
Keywords: adult learning; lifelong learning; personal learning environments; informal learning; higher education

[es] El aprendizaje a lo largo de la vida y los entornos personales de aprendizaje: una simbiosis fructífera en la educación superior

Resumen. INTRODUCCIÓN. El objetivo de este estudio es en primer lugar validar la escala sobre el aprendizaje a lo largo de la vida (LLL), para posteriormente analizar esta perspectiva de aprendizaje y su relación con el enfoque pedagógico de entorno personal de aprendizaje de los estudiantes de último año de diferentes carreras de una universidad costarricense.MÉTODO. Utilizando un diseño no experimental y transaccional, se aplica un cuestionario a una muestra probabilística y representativa (n=1187). Para la validación se lleva a cabo un análisis factorial exploratorio usando el método de máxima versosimilitud con rotación oblimin. El alcance del estudio es descriptivo y correlacional. RESULTADOS. Los resultados muestran que la escala utilizada, se constituye en una herramienta válida y fiable para explorar el tema. Además, se muestra una tendencia moderada en los estudiantes hacia el aprendizaje a lo largo de la vida, principalmente en la capacidad de aplicación de nuevos conocimientos y habilidades en entornos prácticos, así cómo a la hora de relacionar los nuevos aprendizajes con adquisiciones previas. DISCUSIÓN. Se observa una relación significativa entre este enfoque y los entornos personales de aprendizaje, caracterizados por el aprovechamiento del potencial que ofrecen las herramientas tecnológicas. Se han encontrado diferencias significativas en función del género, área de conocimiento, rendimiento académico y horas de conexión a internet. Entre las conclusiones, se evidencia que las universidades deben potenciar las competencias vinculadas con el LLL para potenciar el PLE del estudiantado y propiciar su óptima inserción social y profesional a lo largo de su ruta vital.
Palabras clave: educación adultos; aprendizaje a lo largo de la vida; entorno personal de aprendizaje; aprendizaje informal; educación superior.

[1] This paper has been written in the context of the research project: "Ecologías de aprendizaje en la era digital: nuevas oportunidades para la formación del profesorado de educación secundaria" (ECO4LEARN-SE). It has been partially financed by the Ministry of Science, Innovation and Universities in Spain, (Ref. RTI2018–095690-B-I00)

[2] Universidad Nacional (Costa Rica).
E-mail: jose.garcia.martinez@una.cr
ORCID: https://orcid.org/0000-0003-0709-0814

[3] Universidad de A Coruña (España).
E-mail: mercedes.gonzalez.sanmamed@udc.es
ORCID: https://orcid.org/0000-0002-3410-6810

[4] Universidad de Santiago de Compostela (España).
E-mail: pablocesar.munoz@usc.es
ORCID: https://orcid.org/0000-0001-5417-8136

Cómo citar: García-Martínez, J. A.; González-Sanmamed, M.; Muñoz-Carril, P. C. (2015). Lifelong learning and personal learning environments: a productive symbiosis in higher education. *Revista Complutense de Educación, 34*(1), 167-177.

1. Introduction

Globalization has been accompanied by rapid changes in social, economic, production, and technological areas in all sectors, including education systems. This has been of considerable importance to governments, as well as to the Organization for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), who have turned their gaze to education in general, and higher education in particular, in order to deal with the challenge and help citizens acquire skills.

Many of the responses to this challenge place lifelong learning (LLL) as a keystone, emphasizing that people have more flexibility to direct their own learning in formal environments, reducing the focus on the institution or a specific teacher, and incorporating the multiple opportunities offered by non-formal and informal learning (OECD, 2014; Aoki, 2020). This means that skill development is not limited to a developmental stage or to school or university, but instead extends from birth to old age, covering all environments (family, academic, work,…) and open to society in general (Kaya, 2020).

The acquisition and reinforcement of LLL skills brings many benefits (Grokholskyi et al., 2020) which can be grouped in two aspects: on the one hand, it reduces students' gaps in training, and on the other, it helps to deal with workplace related challenges (Caspersen & Smeby 2020). As a response to the new social demands and challenges, some higher education institutions, not exempt from the pressure of globalization, are making changes in how they manage education (Neelam et al., 2020), leading to new study plans, innovative methodologies, research projects, and extension processes. This is why higher education is considered a key element in the development of LLL (Jaldemark, 2020), not only lifelong but also 'lifewide' (Kirby et al., 2010), above all, focusing interest on the learning, not on the teaching (Vargas, 2014).

Information and communication technologies (ICT) are recognized as drivers of growth and social change (Yen et al., 2019) in almost all areas. However, despite being one of the most common topics of study, its potential in the educational arena is still not being fully tapped (Castañeda et al., 2018). The constant improvements in information access and the rapid appearance of new tools and devices encourage the development of skills, as well as the acquisition of knowledge from formal and informal education with courses, seminars, talks, etc. (OECD, 2014). In a study with workers (Seijas et al., 2016), digital competence was valued the highest for job performance, with particular interest in the use of basic IT applications, effective access and management of information, and knowledge and use of digital communication resources.

In regards to ICT it is considered to be an ally of LLL (Aoki, 2020), and is included in the curriculum in formal education plans, not only in instrumental terms, but to help the student learn to learn (Seijas et al., 2016), and to develop autonomous learning (Yen et al., 2019). This relationship with technology gives rise to the idea of the Personal Learning Environment (PLE), which has become one of the most popular topics in recent years in educational technology, valued as a pedagogical approach which combines the resources, connections and activities that each individual uses for their learning in the digital age (Castañeda & Adell, 2013).

Studies on LLL have based their attention on the definition of the concept and the analysis of its influence and intrinsic association with the political and economic spheres (Erçetin et al., 2019), as well as occupational and social development (Barış, 2018; Tchamyou, 2020). Studies have also been done with university students (Kirby et al., 2010; Demirel & Akkoyunlu, 2017; Kaya, 2020), adult apprentices (Hansen et al., 2019; Sentürk & Duran, 2020), and even on the skills teachers need to promote LLL (Seijas et al., 2016; Kan & Murat, 2020).

1.1. Lifelong learning

It is assumed as a fundamental principle that learning happens throughout life as an inevitable activity (Kirby et al., 2010) and that it does not end with the process of formal education. From that point on, everyone, without exception, should have access to education at any time of their lives, whatever the stage (Bozdemir et al., 2020). From this perspective LLL is an intentional process that places control of learning with the learner, both on a personal and professional level (Knapper & Cropley 2000).

It is a complex term, which has been the cause of debate in many arenas. However, there is a consensus in the scientific community about the flexible nature that permeates it. This flexibility may be seen from various perspectives, on the one hand, in the sense that the learner is not relegated to a formal institution, but instead there are more informal and non-formal environments (Kirby et al., 2010). On the other hand, learning can be continuously reformulated according to objectives, depending on a person's development and needs (Torres & Costa, 2013).

According to the literature review, we have identified various skills that are recommended for LLL, include: goal-setting, applying knowledge and skills, engaging in self-direction and self-evaluation, locating required information, and adapting learning strategies to different conditions (OECD, 2014). Other authors (Seijas et al., 2016) have indicated basic LLL skills in terms of employability: linguistic competence, digital competence, learning to learn, interpersonal and multicultural skills, and entrepreneurial spirit.

Other skills associated with LLL are cognitive (Culver et al., 2019), understood as a person's capacity to self-explore and understand cognitive processes (Yen et al., 2019) which determine aspects related to setting objectives, organizing time, self-direction and self-evaluation of learning, and the ability to apply knowledge and skills to real problems and different situations (Knapper & Cropley, 2000). Other studies have focused on motivation, perseverance, self-regulation, and curiosity (Deveci, 2020). It is also important to note the social nature of the term, learning is done from and with other people (Knapper & Cropley, 2000). In any case, universities can serve as platforms for the development of these skills and competencies, particularly when related to access to information and knowledge generation via research processes (Bozdemir et al., 2020). Below we describe the components of LLL (Kirby et al., 2010) that we have considered in this study:

1. Setting goals: ability and personal disposition for planning and carrying out a specific learning process.
2. Appropriate application of knowledge and skills: a metacognitive process which includes relating learning to previous knowledge and applying it practically.
3. Engaging in self-direction and self-evaluation: the ability to direct and evaluate the self-learning process to achieve planned goals.
4. Locating information: the ability to access and manage information from various sources in various formats.
5. Strategies adapting learning to different conditions: the skill to apply acquired knowledge to solve practical problems, even in uncertain conditions.

1.2 Personal learning environment

Learning, as an inevitable activity that occurs throughout life, involves a personal environment incorporating the main sources of knowledge and the connections produced (Castañeda & Adell, 2013). Over recent years, the proliferation of ITC -especially web 2.0- has meant changes in learning processes (Montebello, 2020), and consequently in the environments that lead to the new pedagogical approach of PLE. This concept cannot be understood without taking advantage of the many possibilities technology offers nowadays, which is one difference from traditional learning environments (Torres & Costa, 2013; Fiedler & Väljataga, 2020). It is not only ICT which nourishes PLE, but also the activities that are done, and especially the social dynamics (Yen et al., 2019) occurring in both formal and informal spaces. PLEs can be structured according to three components (Castañeda & Adell, 2013):

Seeking information: this has become one of the most important components given the huge amount of information we are exposed to and the resources that make searching easier, the management and access to multiple formats which can be adapted to different user needs (Kompen et al., 2019).

Content creation: this PLE component refers to both the process of construction in which new skills of summary, reflection, and structuring are developed, as well as to the product, generating new content or modifying existing content (Castañeda & Adell, 2013).

Sharing information: without doubt an extremely important component which considers the resources and activities focused on relationships, exchange of information, and communication, in short, social connections. This factor is so important within PLE, that there are also Personal Learning Networks (PLN) to share others' knowledge and experience (Torres & Costa, 2013).

1.3. Study objectives

Lifelong learning is characterized by being a conscious, person-centered action, the social and collaborative nature of which is particularly important (Grokholskyi et al., 2020). In this regard, the PLE approach may be complementary in successfully achieving the skills and carrying out the main activities of LLL, which are extremely important for formal and informal educational processes (Sentürk & Duran, 2020). Using the characteristics of LLL and PLE as a reference, we carried out a study to identify and evaluate the connections between the two concepts, and the implications of that on students' higher education.

The objective of this study was to analyze how students in their final year of degrees in Costa Rica perceived lifelong learning and to assess how that related to their personal learning environments. This gave rise to the following specific objectives:

1. Apply and validate the LLL scale (Kirby et al., 2010) with students in higher education in Costa Rica.
2. Reveal this group's lifelong learning according to the components described by Kirby et al. (2010).

3. Identify the relationship between lifelong learning and the components of personal learning environments.
4. Analyze whether gender, the area of study, academic performance, and online time are variables that exert significant influence on the perception of lifelong learning.

2. Method

The study used a quantitative approach. We followed an ex post facto transactional design, bearing in mind that the variables were not manipulated, and data collection was carried out at a single point in time (Hernández et al., 2010). In addition, in coherence with both the literature review and methodological assumptions, the method responds to a descriptive and correlational scope (Hernández et al., 2010).

2.1. Population and sample

The population (N=3165) for this study was made up of final-year university students, doing bachelor's and licentiate degrees at the Omar Dengo & Benjamín Núñez Campus at the National University of Costa Rica (UNA). The sample (n=1187) was stratified probabilistic (Hernández et al., 2010), with each of the faculties and centers considered as a stratum. In defining the sample, we considered representativeness (Table 1), achieving representation of 51 degree courses from the seven areas in the UNA, and size, using the formulation for finite populations.

Table 1. Frequencies and percentages of the population and sample by area of study

Faculties and centers	Population		Sample	
	Frequency	Percentage	Frequency	Percentage
CIDEA[5]	178	5.7	60	5.1
CIDE[6]	469	15.0	235	19.8
Earth and Ocean studies	255	8.2	69	5.8
Social Sciences	1319	42.3	316	26.6
Philosophy and Letters	361	11.6	186	15.7
Health Sciences	198	6.4	118	9.9
Natural Sciences	385	12.4	203	17.1
Total	3165	100.0	1187	100.0

Source: Authors' work based on data from the Registration Department (UNA)

The students were aged between 20 and 57 years old (M=24; SD=4.18). In the participating group 426 (35.9%) were men and 759 (64.1%) were women. In terms of academic performance, 353 students (30.0%) reported never having failed a subject and had average grades over 9, while 313 (26.6%) had not failed any subjects but had grades below 9, and 512 (43.5%) had failed one or more subjects. In terms of online time, 296 students (25%) said that they were online less than 2 hours a day, 520 (43.8%) between 2 and 4 hours, and 370 (31.2%) were online for more than 4 hours a day.

2.2 Data collection techniques and instruments

We used a survey to collect the data, more specifically a questionnaire structured in various blocks with closed and dichotomous questions along with multiple choice questions, asking about personal data, academic data, access to and use of technological devices, and training in ICT. In addition, the survey included the lifelong learning scale (Kirby et al., 2010) which has 14 items with responses from 1 (completely disagree) to 5 (completely agree), measuring the five components described previously. A test of internal consistency gave a Cronbach alpha of .7, similar to the original study (Kirby et al., 2010).

The same questionnaire included the Personal Learning Environment Activities Scale (PLEAS; García-Martínez et al., 2021), containing 27 items with response options from 1 (completely disagree) to 5 (completely agree), measuring three factors that are recognized in PLEs: Seeking information, sharing information, and creating content. Testing for internal consistency gave a Cronbach alpha of .95.

[5] Centro de Investigación, Docencia y Extensión Artística [Research Center: Teaching and the Arts]

[6] Centro de Investigación en Docencia y Educación [Research Center in Teaching and Education]

2.3 Procedure

The questionnaire was submitted for validation by 20 experts in higher education and research methodology. Following that, we performed a pilot study with a sample of 45 students with similar characteristics to the final sample. Based on the results of those two processes, the final version of the instrument was produced. The questionnaire was applied in classrooms, with the prior coordination of those in charge of the different faculties. The students had 20 minutes to complete the questionnaire. When it was introduced, the students were given an explanation of the aims of the study, how the data would be treated, and the voluntary, anonymous and confidential nature of the study.

2.4 Data analysis

We produced a database using the SPSS v.21 statistics package. First, we performed the Kaiser-Meyer-Olkin (KMO) test and Bartlett's sphericity test to assess the suitability of the sample. Then, we performed an exploratory factor analysis (EFA) using the maximum likelihood method with oblimin rotation, following the calculation of a Pearson correlation matrix. Second, we obtained descriptive statistics for the items, as well as the components and the overall scale. Third, we performed a multiple regression test, and finally we carried out Student t and MANOVA tests to compare means between groups.

3. Results

3.1 Validation of the LLL scale

The result of the KMO test was .791, and the result of Bartlett's sphericity test was significant ($\chi 2$ (N=1187, 78) = 2221.9, p=.000), meeting the conditions needed to perform EFA. For the EFA we used maximum likelihood method with oblimin rotation. We extracted 4 components in the final solution, in contrast to the five proposed in the original scale (Kirby et al. 2010). We also eliminated item 4 as it gave a value below .50 (Kline, 2011). The four factors explained 53.5% of the total variance, with saturations ranging between .51 and .81 (Table 2). The first component, with an eigenvalue of 3.05, explained 23.5% of the variance explained and measures the variable "goal setting". The second component, with a total value of 1.85, explained 14.5% of the variance and corresponds to the variable "knowledge and skills". The third component, with a value of 1.09, explained 8.4% of the variance and measures the variable "self-direction and evaluation". Finally, the fourth factor, with a value of 1.00, explained 7.4% of the variance and refers to the variable "adaptable learning strategies".

Table 2. Matrix of rotated components, eigenvalues and variance explained by the factors

Item	Component			
	1	2	3	4
1	**.702**	.041	.169	-.149
6	**.696**	-.064	.223	-.012
7	**.646**	.204	-.081	-.231
9	**.555**	-.102	.462	.035
14	**.542**	-.108	.125	.275
11	**.501**	-.309	.056	.385
5	.019	**.798**	-.004	-.056
12	-.081	**.626**	-.169	.202
10	.044	**.569**	-.016	.322
8	.079	-.047	**.812**	-.081
13	.269	-.071	**.742**	-.059
2	.033	.183	-.229	**.723**
3	-.188	.350	.056	**.570**
Eigenvalue	3.05	1.85	1.09	1.00
Variance	23.5	14.5	8.4	7.4

To complement the validation. we performed a Pearson correlation analysis between the overall scale and the components resulting from the EFA. The results (Table 3) show coefficients between .50 and .81 both between the components and with the overall scale.

Table 3. Correlation matrix for the overall scale and components

	1	2	3	4	5
Overall LLL scale (1)	1	.863**	.663**	.630**	.590**
Goal-setting (2)		1	.355**	.411**	.331**
Knowledge and skills (3)			1	.277**	.312**
Self-direction and evaluation (4)				1	.257**
Learning strategies (5)					1

**. The correlation is significant at a level of 0.01 (bilateral).

3.2 Descriptive analysis of the LLL scale

We analyzed the data to extract statistics of central tendency and distribution in order to observe how the items behaved (Table 4). In order to obtain means for the factors. we recoded items written negatively (1. 2. 6. 8. and 11). The mean scores ranged between a minimum of 3.08 (item 8) and a maximum of 4.28 (item 13). The standard deviations were between .82 (item 10) and 1.21 (item 8), and both statistics displayed normal behavior. The data for asymmetry ranged between -.02 and 1.20. Lastly, values for Kurtosis were between .06 and 1.82. Finney & DiStefano (2006) suggested maximum values of two for asymmetry and seven for kurtosis. Table 4 shows that the items in the scale presented normal distributions. The mean value of the overall scale of lifelong learning was M=3.79 (SD=.46). With respect to the components, it is worth highlighting that students scored highest in application of skills and knowledge (M=4.08; SD=.64), followed by adaptable learning strategies for different conditions (M=3.74; SD=.72), engaging in self-direction and self-evaluation (M=3.68; SD=.74), and lastly goal-setting (M=3.66; SD=.57).

Table 4. Descriptive statistics of the scale, components, and items.

Component/item	M	SD	As	Kr
Goal-setting	3.66	.57	.05	-.23
1. I prefer to have others plan my learning	3.79	1.03	-.47	-.55
6. I seldom think about my own learning and how to improve it	3.53	1.20	.43	-.83
7. I feel I am a self-directed learner	3.63	.98	-.40	-.27
9. I love learning for its own sake	3.93	.97	-.72	.06
14. When I learn something new, I try to focus on the details rather than on the 'big picture'	3.72	.98	-.42	-.22
11. I often find it difficult to locate information when I need it	3.38	1.19	.30	-.91
Application of knowledge and skills	4.08	.64	-.61	.49
5. I am able to impose meaning upon what others see as disorder	3.77	.93	-.53	.06
12. When I approach new material, I try to relate it to what I already know	4.23	.82	-1.01	1.28
10. I try to relate academic learning to practical issues	4.25	.82	-1.0	1.24
Self-direction and self-evaluation	3.68	.74	-.04	-.29
8. I feel others are in a better position than I am to evaluate my success as a student	3.08	1.21	-.02	-.91
1313. It is my responsibility to make sense of what I learn at university	4.28	.84	-1.20	1.82
Adapting learning strategies to different conditions	3.74	.72	-.47	.21
2. I prefer problems for which there is only one solution	3.76	1.05	.65	-.60
3. I can deal with the unexpected and solve problems as they arise	3.73	.96	-.77	.45
Overall lifelong learning scale	3.79	.46	.06	-.31

3.3 Relationship between lifelong learning and personal learning environments

To examine the relationship between LLL and PLEs, we firstly performed a Pearson correlation analysis to examine the strength of the relationship and whether there was a reliable association between the different

variables analyzed in this study (Table 5). As the table shows, there was a significant association between the two (p<.001).

Table 5. Matrix of correlations and statistics between PLE components and the LLL scale

Components	Search	Create	Share	LLL scale	M	SD
Search	1	.481**	.492**	.611**	3.75	.89
Create	.481**	1	.488**	.538**	2.89	.95
Share	.492**	.488**	1	.468**	2.13	.97
LLL scale	.611**	.538**	.468**	1	3.79	.46

** The correlation is significant at the level of .01 (bilateral)

To examine this relationship more deeply, we performed a multiple regression analysis with the PLE components as predictor variables and lifelong learning as a dependent variable, which explained 59% of the variance of the latter. The searching for information component explained 37.4% of the total variance, creating content explained 14% and sharing information 7.6%. The result of the ANOVA test indicates that this is significant (F (3,1180) =562.3; p=.000), limiting the presence of randomness in the variation of the model. Subsequently, we performed a multiple regression with all of the lifelong learning components as criterion variables (Table 6), which gave significant values in all cases.

Table 6. Standardized regression coefficients for the relationship between lifelong learning and its components and the components of PLE

	Predictors					
	Search		Create		Share	
	B	t	β	T	β	T
Lifelong learning	.436	21.84**	.351	17.75**	.285	14.62**
Goal-setting	.381	16.36**	.318	13.82**	.226	9.95**
Knowledge	.280	10.38**	.232	8.68**	.188	7.12**
Self-direction	.276	10.05**	.198	7.27**	.183	6.80**
Strategies	.236	8.58**	.199	7.30**	.222	8.26**

Note: **significant at a level .01; n = 1187; R2 = .59 **

3.4 Analysis of gender-related differences in LLL

Table 7 gives the group statistics and the results of the Student t test in relation to sex. Women had higher mean scores in all of the components, with significant differences in both the overall lifelong learning scale and in the components knowledge and skills, and self-direction and self-evaluation.

Table 7. Group statistics and results of the Student t test for the components of the LLL scale in relation to the variable gender

Variable "gender"	**Group statistics**			**T test for equality of means**		
	Sex	**Mean**	**SD**	**t**	**df**	**Sig. (bi-lateral)**
Overall LLL scale	H	3.73	.47	2.529	1180	.012
	M	3.80	.46			
Goal-setting	H	3.63	.55	1.230	1180	.219
	M	3.67	.58			
Knowledge and skills	H	4.00	.68	3.087	1180	.002
	M	4.13	.61			
Self-direction and self-evaluation	H	3.61	.73	2.342	1180	.019
	M	3.72	.75			

Learning strategies	H	3.71	.73	1.104	1180	.270

3.5 Analysis of differences in LLL in relation to academic performance

We performed a unidirectional analysis of variance between groups to examine the differences in academic performance (independent variable) in lifelong learning, using the components of the LLL scale as dependent variables. Before performing the MANOVA for academic performance, we examined the homogeneity of covariance using Box's M. The result (Box's M= 112.29, F= 3.72, p=.000) showed that the assumption was not met. Given that, we decided to use Pillai's Trace for the multivariate analysis of significance of main effects, following the recommendations from Tabachnick & Fidell (2001). The MANOVA showed a significant main effect for academic performance, Pillai's Trace= .030, F (10, 2338) = 3.608, p=.000, η2= .015. Subsequent univariate ANOVAs demonstrated that students who reported not having failed any subjects and who had an average grade of 9 or higher had significantly higher scores than those who had not failed but had an average grade below 9 and those who had failed a subject, both in the overall lifelong learning scale [F(2,1172)= 13.99, p=.000], as well as in each of the components: goal-setting [F(2,1172)= 8.10, p=.000]; knowledge and abilities [F(2,1172)= 10.06, p=.000]; self-direction and self-evaluation [F(2,1172)= 6.82, p=.001]; and adaptable learning strategies [F(2,1172)= 6.83, p=.001].

3.6 Analysis of differences in LLL in relation to the area of study variable.

In the same way as the previous case, before the MANOVA for the area of study variable, we examined the homogeneity of covariance using Box's M. The result (Box's M= 1263.42, F= 16.59, p=.000) indicated non-equivalence of covariance, thus we opted to use Pillai's Trace. This analysis demonstrated a significant main effect for the variable area of study, Pillai's Trace= .060, F (30, 5885) =2.394, p=.000, η2= .012. Subsequent univariate ANOVAs showed that students who were studying arts (CIDEA) scored significantly higher (M=3.94; SD=.42) than students from social sciences (M=3.68; SD=.45) or healthcare sciences (M=3.71; SD=.44) in the overall lifelong learning scale [F(6,1177)= 5.557, p=.000]. In the same scale, students from education (CIDE) scored higher (M=3.87; SD=.49) than students from social sciences. There were significant differences in the component knowledge and skills [F(6,1172)= 6.24, p=.000]: where students from arts (M=4.36; SD=.55), education (M=4.18; SD=.65), and philosophy and the arts (M=4.11; SD=.63) scored higher than students from social sciences (M=3.92; SD=.67). Finally, there were significant differences in the self-direction and self-evaluation component [F(6,1172)= 2.95, p=.007]: with students from education (M=3.81; SD=.78) scoring higher than students from earth and ocean studies (M=3.49; SD=.69).

3.7 Analysis of differences in LLL in relation to the variable online time

We performed the same MANOVA test for the variable online time, and as before, we examined the homogeneity of covariance using Box's M. The result (Box's M= 142.140, F= 4.708, p=.000) indicated that the assumption was not met, thus we opted to use Pillai's Trace. This analysis demonstrated a significant main effect for the variable online time, Pillai's Trace= .017, F (5, 1177) =3990, p=.001, η2= .017. Subsequent univariate ANOVAs demonstrated that in the overall lifelong learning scale [F (2,1180)= 9.532, p=.000], students who spent more than 4 hours a day online scored significantly higher (M=3.83; SD=.50) than students who spent between 2 and 4 hours online (M=3.79; SD=.43) or students who spent less than 2 hours a day online (M=3.67; SD=.46). We found significant differences in the components of goal-setting [F (2,1180)= 6.45, p=.002] and knowledge and skills [F(2,1180)= 6.45, p=.002], with those spending 4 or more hours online scoring higher than the other two groups. Finally, there were significant differences in the component adaptable learning strategies [F (2,1180) = 3.03, p=.049] between students spending 4 hours or more online (M=3.80; SD=.78) and students spending less than 2 hours online (M=3.66; SD=.72).

4. Discussion and conclusions

It is extremely important to understand final-year university students' skills in lifelong learning considering the changes in both education and in the workplace that they will soon be joining (Grokholskyi et al., 2020). In this regard it is worth underlining that the study of their perceptions will provide an understanding of aspects related to the continued ability to learn that they will need once they leave the formal educational environment. In addition, linking this analysis with the configuration of personal learning environments will help to evaluate opportunities to make the most of technological tools that are currently available. Similarly, higher education institutions may benefit from these types of study by promoting skills and abilities that relate to LLL from formal education and allowing the enrichment of the PLEs that students are creating for their entry into the world of work.

In this respect, the satisfactory results we obtained from the lifelong learning scale proposed by Kirby et al. (2010) at a statistical level –both in the validation and in the analysis of the items and the components extracted by the exploratory factor analysis– underscores that it is relevant and suitable to be used to better understand university students' skills and abilities.

In terms of the internal scale structure, the exploratory factor analysis demonstrated the saturation of the items in four factors (Table 2) as opposed to the five proposed in the theoretical model in the original scale proposed by Kirby et al. (2010). The factor which was discarded was locating information, with item 11 measuring the goal setting factor. It is also worth noting that item 4 "I feel uncomfortable in uncertain conditions" was removed as it had a value below .5. Despite these changes, it is clear that there is good consistency between the proposed conceptual model and the results of the factor analysis (Table 2), complemented by the Pearson correlations between the extracted components being positive and high (Hernández et al., 2010). In addition, the Cronbach alpha for testing internal consistency gave a coefficient that was moderate (.70) but reliable.

At the statistical level, the data we obtained, both of central tendency and distribution, behaved adequately. This supports the idea that the LLL scale is a valid, reliable resource to be used in future studies on this topic. The mean scores of the LLL scale (Table 4) demonstrated a general moderate trend towards students' permanent learning, which is in line with similar studies (Kirby et al., 2010; Kan & Murat, 2020;). This result may be affected by the influence of formal learning, with the possibility that the core of learning is focused on the institution and not on the student (Knapper & Cropley, 2000). This finding is worth paying attention to, as it could impact challenges related to continued training once university study is complete, and therefore, the proper acquisition of knowledge and skills needed for a dynamic, complex work environment (Grokholskyi et al., 2020). When it comes to the components, we should note that the students scored highly in the appropriate application of knowledge and abilities, which indicates that students exhibit the capacity to apply their knowledge to practical situations, as well as to relate new learning to prior knowledge, involving a process of reflection that is useful for LLL (Culver et al., 2019). The remaining components were scored moderately. Although that is not a bad result, it is worth paying attention to the data in the sense that a lack of skills in goal-setting or in self-direction might lead to a drop in motivation to learn, particularly in the adult population (Sentürk & Duran, 2020). Similarly, not participating in the process of self-evaluation, including in formal environments, may prevent the development of optimum skills for LLL (Deveci, 2020).

The relationship between LLL and PLEs is clear from the multiple regression analysis. Firstly, the results showed a positive, significant relationship, in the sense that the better developed the PLE, the better the scores in the LLL scale. These data support the idea that PLEs involve student participation in ecosystems that favor continuous learning throughout life (Torres & Costa, 2013; Fiedler & Väljataga, 2020). The results show how the components of PLE explain 59% of the variance. This is in line with various studies (Seijas et al., 2016; Demirel & Akkoyunlu, 2017), recognizing the contribution of digital competence in LLL. The searching for information component stands out for the variance it explains (37%), which can be explained if one considers the huge amount of information available nowadays, as well as the different ways to access it and the multiple formats it can be found in. In this regard, IT literacy is needed in the profile of the lifelong learner (Aoki, 2020) which facilitates the search for, management, and reading of information, as well as the possibility of adapting to different learning styles and needs (Kompen et al., 2019). The creating content component, which explained 14% of the variance, takes on particular importance by adding mechanisms of reflection, summarization, and organization, amongst others to the PLE (Castañeda & Adell, 2013), in addition to other desirable metacognitive processes for LLL (Culver et al., 2019), encouraging self-reflection about the learning process, allowing self-regulation (Grokholskyi et al., 2020). Finally, the sharing information component (8%) nods to the social aspect of the model (Yen et al., 2019), from the idea that learning is both an individual and collective process (Knapper & Cropley, 2000). In that regard, many authors have identified social and interpersonal skills (Sejias et al., 2016; Demirel & Akkoyunlu, 2017) as an inescapable part of the skills required for LLL.

We identified significant differences by gender in the LLL scale and the components application of knowledge and abilities and engaging in self-direction and evaluation. Women scored higher than men, which is similar to some other studies (Kan & Murat, 2020), however, others have differed, finding no differences in this regard (Kirby et al., 2010). Our results should be interpreted with caution, on the one hand on a methodological level, given the lack of an experimental design that would allow manipulation of variables and offer causal results. And on the other, because of the lack of studies that can explain this phenomenon. Nonetheless, these results may be due to cultural factors that are often present behind some differences of this type.

With respect to the variable area of study, the results demonstrated differences in students who were studying art, education, and humanities, who scored higher in LLL or in some component compared to students of social sciences, healthcare, and earth and ocean studies. This is in line with other studies (Demirel & Akkoyunlu, 2017) which have shown strong tendencies towards LLL in future teachers. This may be due to the pedagogical component in the teaching plans for arts and education degrees, as a high proportion of these students will go on to teach.

We found significant differences in the analysis of LLL related to the academic performance variable. Students who had high average grades and who had never failed a subject had higher scores in LLL. There is a relationship, but the lack of studies that go deeper into causality mean that we do not know whether LLL

skills impact academic achievement or vice versa. In any case, the relationship in the data is not random, and studies in this regard (Nelson et al., 2014) indicate that students with the highest scores tend to have better understanding and use of multiple strategies and resources, better abilities to discuss and reflect on the learning process, and better application of knowledge to real situations, all of which are linked to LLL (Knapper & Cropley, 2000) and PLEs (Castañeda & Adell, 2013).

Finally, we found significant differences in LLL in relation to the time connected online. Those who spent more time connected to the internet had higher scores. This shows how the use of ICT influences learning processes, making it an ideal complement for learning (Seijas et al., 2016; Aoki, 2020) and developing autonomous learning (Yen et al., 2019).

Our study aids the understanding of the skills and abilities that university students have around lifelong learning, and how the development of personal learning environments has become a complementary approach for dealing with the challenges of modern day society, making use of the potential of ICT. Universities are a fundamental pillar in the promotion of these skills, and in ensuring students' autonomy of learning during higher education, especially once it is finished.

Therefore, from the point of view of each individual and from the institutional perspective (particularly in the field of higher education), it is of interest to situate, analyze and assess the results of this study from the perspective of the so-called learning ecologies (González-Sanmamed et al., 2020; Sangrá et al., 2019). This concept points to the understanding of the processes, mechanisms, resources, contexts and interactions that each person uses to learn in the digital age, combining fase-to-face, non-face-to-face and hybrid modalities, and integrating the formal, non-formal and informal systems that each person has available during their vital trajectory and from the necessary idea of learning throughout life (González-Sanmamed et al., 2019).

In terms of future research, we suggest two lines of action. One is to address other types of learning, informal and non-formal, and what they provide to lifelong learning. In regards to this, it might be interesting to include the perspective of learning ecologies as an approach from which to analyze how each person faces their learning from their own life history, and in particular, making the most of the opportunities provided by technology. In addition, it would be advisable to use longitudinal studies which would allow us to identify the acquisition of skills and abilities in LLL throughout university degree courses.

5. References

Aoki, K. (2020). Technologies for Lifelong and Lifewide Learning and Recognition: A Vision for the Future. In, S. Yu, M. Ally & A. Tsinakos (Ed.), *Emerging Technologies and Pedagogies in the Curriculum. Bridging Human and Machine: Future Education with Intelligence*. (pp. 41-52). Springer.

Barış, E. T. 2018. Lifelong Learning Phenomenon in Migration. In Ş. Erçetin (Ed.), *Educational Development and Infrastructure for Immigrants and Refugees*. (pp.196-202). IGI Global.

Bozdemir, H., Aşkin, İ., & Faiz, M. (2020). Investigation of Primary School Teacher Candidates' Lifelong Learning Tendencies and Emotional Intelligence Levels. *Cukurova University Faculty of Education Journal*, *49*(1), 352–381. https://dergipark.org.tr/tr/pub/cuefd/issue/53758/595336

Caspersen, J., & Smeby, J. C. (2020). Placement training and learning outcomes in social work education. *Studies in Higher Education*, 1-14. https://doi.org/10.1080/03075079.2020.1750583

Castañeda, L., & Adell, J. (2013). *Learning Environments: keys to the online educational ecosystem*. Alcoy: Marfil.

Castañeda, L., Esteve, F., & Adell, J. (2018). Why rethinking teaching competence for the digital world? *Revista de Educación a Distancia*, *56*(1), 1-20. https://revistas.um.es/red/article/view/321581

Culver, K. C., Braxton, J., & Pascarella, E. (2019). Does teaching rigorously really enhance undergraduates' intellectual development? The relationship of academic rigor with critical thinking skills and lifelong learning motivations. *Higher Education, 78*(4), 611-627. doi:10.1007/s10734-019-00361-z

Demirel, M., & Akkoyunlu, B. (2017). Prospective Teachers' Lifelong Learning Tendencies and Information Literacy Self-Efficacy. *Educational Research and Reviews*, *12*(6), 329-337. https://academicjournals.org/journal/ERR/article-abstract/696759563252

Deveci, T. (2020). Promoting lifelong learning. *Asian EFL Journal*, *24*(3), 4-19.

Erçetin, Ş. Ş., Ray, N., & Sen, S. (2019). *Economic Growth and Demographic Transition in Third World Nations: A Chaos and Complexity Theory Perspective*. CRC Press.

Fiedler, S. H., & Väljataga, T. (2020). Modeling the personal adult learner: the concept of PLE re-interpreted. *Interactive Learning Environments*, *20*(1), 1-13. doi:10.1080/10494820.2020.1734027

Finney, S.J., & DiStefano, C. (2006). Non-normal and categorical data in structural equation modeling. In G.R., Hancock, & R.O., Mueller (Eds.) *Structural equation modeling: A second course.* (pp. 269-314). Greenwich: Information Age Publishing.

García-Martínez, J. A., González-Sanmamed, M., & Muñoz-Carril, P. C. (2021). Construction and Validation of the Activities' Scale in the Personal Learning Environments of Higher Education Students. *Psicothema*, *33*(2), 320-327. doi:10.7334/psicothema2020.259

González-Sanmamed, M., Muñoz-Carril, P. C., & Santos-Caamaño, F. J. (2019). Key components of learning ecologies: A Delphi assessment. *British Journal of Educational Technology*, *5*(4), 1639-1655. doi.org/10.1111/bjet.12805

González-Sanmamed, M., Sangrà, A., Souto-Seijo, A., & Estévez, I. (2020). Learning ecologies in the digital era: challenges for higher education. *Publicaciones*, *50*(1), 83–102. doi.org/10.30827/publicaciones.v50i1.15671

Grokholskyi, V. L., Kaida, N. I., Albul, S. V., Ryzhkov, E. V., & Trehub, S. Y. (2020). Cognitive and metacognitive aspects of the development of lifelong learning competencies in law students. *International Journal of Cognitive Research in Science, Engineering and Education*, *8*(2), 1-14. doi: 10.5937/IJCRSEE2002001G

Hansen, R. J., Talmage, C. A., Thaxton, S. P., & Knopf, R. C. (2019). Barriers to Age-Friendly Universities (AFU): Lessons from Osher Lifelong Learning Institute demographics and perceptions. *Gerontology & geriatrics education*, *40*(2), 221-243. doi:10.1080/02701960.2019.1572003

Hernández, R., Fernández, C., & Baptista, P. (2010). *Investigation methodology*. México: Editorial Mc Graw Hill.

Jaldemark, J. (2020). Formal and informal paths of lifelong learning: Hybrid distance educational settings for the digital era. In M.F. Cleveland-Innes & D.R. Garrison (Eds.) *An introduction to distance education: Understanding teaching and learning in a new era*. (pp. 25-42). New York: Routledge.

Kan, A. Ü., and Murat, A. (2020). Examining the self-efficacy of teacher candidates' lifelong learning key competences and educational technology standards. *Education and Information Technologies*, *25*(2), 707-724. doi:10.1007/s10639-019-10072-8

Kaya, K. (2020). Examining the Lifelong Learning Tendencies of Sport Sciences Faculty Students. *Journal of Education and Learning*, *9*(3). 99-105. doi:10.5539/jel.v9n3p99

Kirby, J. R., Knapper, C., Lamon, P., & Egnatoff, W. J. (2010). Development of a scale to measure lifelong learning. *International Journal of Lifelong Education*, *29*(3), 291-302. doi:10.1080/02601371003700584

Kline, R. B. (2011). *Principles and practice of structural equation modelling* (3rd ed.). New York: Guilford Press.

Knapper, C., & Cropley, A. J. (2000). *Lifelong learning in higher education*. Sterling: Stylus Publishing Inc.

Kompen, R., Edirisingha, P., Canaleta, X., Alsina, M., & Monguet, J. M. (2019). Personal learning Environments based on Web 2.0 services in higher education. *Telematics and Informatics*, *38*, 194-206. doi:10.1016/j.tele.2018.10.003

Montebello, M. (2020). I Am the Institution: A Personal Learning Environment. In M. Montebello (Ed.). *Handbook of Research on Digital Learning.* (pp. 291-301). IGI Global.

Neelam, N., Sheorey, P., Bhattacharya, S., & Kunte, M. (2020). Organization for Economic Co-operation and Development guidelines for learning organization in higher education and its impact on lifelong learning–evidence from Indian business schools. *Journal of Information and Knowledge Management Systems*. *50*(4), 569-596. doi:10.1108/VJIKMS-09-2019-0144

Nelson-Laird, T. F., Seifert, T. A., Pascarella, E. T., Mayhew, M. J., & Blaich, C. F. (2014). Deeply affecting first year students' thinking: deep approaches to learning and three dimensions of cognitive development. *The Journal of Higher Education*, *85*(3), 402–432. doi:10.1080/00221546.2014.11777333

OECD. (2014). Recognition of non-formal and informal learning. http://www.oecd.org/edu/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm

Sangrá, A., Raffaghelli, J. E., & Guitert, M. (2019). Learning ecologies through a lens: Ontological, methodological and applicative issues. A systematic review of the literature. *British Journal of Educational Technology*, *50*(4), 1619-1638. doi.org/10.1111/bjet.12795.

Seijas, E. J., Val, J. C., Cadavid, M. A. M., & Antelo, B. G. (2016). Training of the university teaching staff on lifelong learning competences from the requests of employers and graduates. *Revista de Investigación Educativa*, *34*(1), 69-85. doi:10.6018/rie.34.1.215341

Sentürk, S., & Duran, V. (2020). Lifelong learning tendencies of trainers in adult education. *International Journal of Evaluation and Research in Education*, *9* (1), 1-9. doi:10.11591/ijere.v9i1.20365

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics*. New York: HarperCollins.

Torres, R., & Costa, C. (2013). Continuous training, lifelong learning and PLEs. In L. Castañeda y J. Adell (Eds.) *Personal Learning Environments: keys to the online educational ecosystem*, (pp.85-92). Alcoy: Marfil.

Vargas, C. (2014). Lifelong Learning principles and higher education policies. *Tuning Journal for Higher Education*, *2*(1), 91-105. doi:10.18543/tjhe-2(1)-2014pp91-105

Yen, C. J., Tu, C. H., Sujo-Montes, L. E., Harati, H., & Rodas, C. R. (2019). Using personal learning environment (PLE) management to support digital lifelong learning. *International Journal of Online Pedagogy and Course Design*, *9*(3), 13-31. doi:10.4018/IJOPCD.2019070102