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# Using Personal Learning Environment (PLE) Management to Support Digital Lifelong Learning

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## ABSTRACT

Personal Learning Environment is a promising pedagogical approach to integrate formal and informal learning in social media and support student self-regulated learning. The use of PLEs to support lifelong learning can be expanded to the formal, non-formal, or informal learning environments. This study empirically examined how PLE management predicted the use of PLE to support three types of lifelong learning (i.e., formal, non-formal, or informal learning). This study concluded that PLE management was predictive of each type of learning respectively. PLE is not only a technical platform but also a new digital learning literacy, conceptual space, pedagogical process, and social networks that enable and support learners to achieve their lifelong learning goals. While Open Educational Resources (OERs) are perceived as a solution for social justice in digital lifelong learning, PLE and Open Network Learning Environment are identified as the key pedagogy and instructional strategies to empower learners gaining network-learning literacy and becoming competent digital lifelong learners.

## KEYWORDS

Lifelong Learning, Network Learning Literacy, Open Network Learning, Personal Learning Environment, Self-Regulated Learning

## INTRODUCTION

The prevalence of Open Educational Resources (OER), Web 2.0 tools, and Massive Open Online Courses (MOOCs), readily available lifelong learning is attracting the attention of people worldwide. The emerging practices of lifelong learning signals the need for more personal, social, and participatory approaches in learning, which support the active use and co-creation of learning resources to enrich learning processes and meet the personal needs of the learners (Leone, 2013). Regardless of its types (i.e., formal, non-formal, or informal learning), learning is always personal, collaborative, constructive, connective, and ubiquitous. Research reveals that Personal Learning Environments (PLEs) can be integrated into formal and informal learning (McLoughlin & Lee, 2010). PLE is a potentially promising pedagogical approach to integrate formal and informal learning in social media and to support student self-regulated learning (SRL) (Dabbagh & Kitsantas, 2012). As suggested by Ivanova and Chatti (2010), educators should foster organization of self-directed learning with open

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network environments where learners are allowed to select their own learning tools, services for the access of content and human intelligence inside and outside the educational institutions. Given that learning primarily occurs outside traditional formal situations (Leone, 2013), the use of PLE to support lifelong learning should be implemented not only in the formal education setting but also in the non-formal and informal environments (Greller & Drachler, 2012). Therefore, it will be important to understand how PLE management can predict the actual use of PLE to support lifelong learning.

This study empirically examined the following research questions:

1. How will each of the three aspects of personal learning environment (PLE) management (i.e., level of initiative, sense of control, and level of self-reflection) respectively predict the use of PLE to support formal learning?
2. How will each of the three aspects of personal learning environment (PLE) management (i.e., level of initiative, sense of control, and level of self-reflection) respectively predict the use of PLE to support non-formal learning?
3. How will each of the three aspects of personal learning environment (PLE) management (i.e., level of initiative, sense of control, and level of self-reflection) respectively predict the use of PLE to support informal learning?

## **DIGITAL LIFELONG LEARNING**

Lifelong learning includes formal learning, non-formal learning, and informal learning (OECD, 2014) that are undertaken throughout life, resulting in an improvement in knowledge, skills and competences within a personal-, civic-, social- and/or employment-related perspective. Lifelong learning includes the provision of counseling and guidance services (Commission of the European Communities, 2001). Although formal learning is important in lifelong learning, non-formal and informal learning are estimated to constitute 70-90% of lifelong learning and is insufficiently represented in the literature of open and distance learning and development (Latchem, 2014). This is because most people's learning throughout their lifespans is informal, occurring in family, community, and work settings (Jeffs & Smith, 1997, 2005, 2011) and much of what they also learn is by means of non-formal education (Latchem, 2014). Hall (2009) argued "more learning needs to be done at home, in offices and kitchens, in the contexts of where knowledge is deployed to solve problems and add value to people's lives" (p. 31).

Lifelong learning consists of skills, knowledge, and practice. With the prevalence of open tools, pedagogy, and resources, the lines among formal learning, non-formal learning, and informal learning are blurred. Digital lifelong learning is the ultimate means for all citizens to realize their lifelong goals. Digital lifelong learners can transform learning from self-actualization to goal-realization. Digital open and network learning is a critical pedagogy to bridge formal and informal learning by facilitating and recognizing lifelong learning with effective innovative pedagogies. Because digital and open education can embrace the complexity of networked learning and can value the condition of emergence that networked learning empowers, there should be time to encourage networked learning as a structure and a disposition, a design and a habit of being (Campbell, 2016).

Digital lifelong learning is a learner-centered activity in which learners of different cultures and life paths use digital technology to improve their diversified learning perspectives (Gibson, Rimmington, & Landwehr-Brown, 2008). Effective digital lifelong learning does not occur in one course nor can one just become a good cybercitizen; it requires human beings with the necessary skills and knowledge to participate effectively as responsible members of society (Waters, 2012). Thus, it is critical for lifelong learners to permeate formal, non-formal, and informal learning experiences on the home campus, local community, and in the global community (Olson, Green, & Hill, 2006) to grasp the interdependent and interconnected nature of digital learning, and to assume social learning responsibilities to make learning communities and environments better.

Researchers have focused on digital lifelong learning from the perspectives of curriculum, pedagogy, and digital technology. Caron, Beaudoin, Leblanc, and Grant (2007) proposed an architecture, including theoretical (pedagogical) and technological perspectives, for the implementation of an online lifelong learning environment. Allowing the transfer of learning credit would connect formal and non-formal education to achieve and harvest innovative learning (Schuwer et al., 2015). In addition, Donnison (2009) argued that higher education and teacher education programs need to consider the relationship between Generation Y, lifelong learning, and change agency while aligning pedagogy and curriculum with the new generation of students. Mariki (2014) concurred about the essentiality of possessing skills in the development of technological innovations among open and distance learning teachers, in both formal and non-formal education systems.

## Formal Learning

Formal learning is organized, structured and has learning objectives. Educational institutions formally recognize it with credits, degrees, or other recognitions. From the learner's standpoint, it is intentional, i.e., the learner's explicit objective is to gain knowledge, skills and/or competences (OECD, 2014). In fact, formal learning is now acknowledged as a much smaller percentage of a learner's overall experience (Chen & Bryer, 2012). Milligan and Littlejohn (2014) noticed that formal learning opportunities are opening up through MOOCs, providing free and flexible access to formal education for millions of learners worldwide.

## Non-formal Learning

Non-formal learning is situated between formal and informal learning and it happens in a formal learning environment that is institutionally based and structured but is not formally recognized (Selwyn, Gorard, & Furlong, 2006). It typically involves workshops, training sessions, community courses, interest-based courses, short courses, or conference style seminars. Non-formal learning affords some flexibility between formal and informal learning (OECD, 2014). Non-formal learning is intentional from the learner's point of view, but it typically does not lead to a certification. It is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time, or learning support), but which contain an important learning element (OECD, 2005, pp. 5-6).

Recently, educators investigated the value of digital non-formal learning. Researchers have focused on examining how instructional activities, digital learning, and learning outcomes may relate to non-formal learning. Tang, Wong, Li, and Cheng (2017) research findings indicated that digital non-formal learning provided opportunities for service learning, co-curricular activities, and student exchange programs with different objects of engagement. In addition, Mirzaee and Hasrati (2014) recognized that formative written feedback provided on students' writings could lead to digital non-formal learning because it encourages them to act upon it.

Harju, Pehkonen, and Niemi (2016) concluded that blogging can promote non-formal lifelong learning in many ways. Blogs and blogging constitute a learning environment that promotes active participation by making interesting, meaningful, and enjoyable activities possible and, consequently, provide the enthusiasm to actively learn and develop. Moreover, Farrow, de los Arcos, Pitt, and Weller (2015) noted that OERs have been identified as having the potential to extend opportunities for digital non-formal learning. They concluded that non-formal learners are keen about using OERs.

In MOOCs and blended learning, Gutiérrez-Santiuste, Gámiz-Sánchez, and Gutiérrez-Pérez (2015) observed that non-formal learners give more general reasons for arguing their satisfaction and expressing their dissatisfaction primarily with planning, design, and assessment. O'Toole (2013) concluded similar findings that non-formal MOOC students demonstrated great difficulties with assessment. Additionally, non-formal learners are highly satisfied with participation while formal learners ascribed higher point values to satisfaction with contents in MOOCs and blended learning (Gutiérrez-Santiuste et al., 2015). They also observed that non-formal learners perceived a greater presence of technical barriers while formal learners perceived greater cognitive barriers.

## Informal Learning

Informal learning is never organized, has no clearly set objective in terms of learning outcomes, and is never intentional from the learner's standpoint. Often, it is referred to as learning by experience or just as experience for the aims and pursuit of knowledge and skills (OECD, 2014), such as reading selected books, self-study programs, performance support materials and systems, receptivity of coaching or mentoring, and communities of practice (Paradise & Rogoff, 2009). Researchers (Khaddage, Müller, & Flintoff, 2016; Pulla, 2017) foresee that mobile learning is a way to bridge formal and informal learning.

## PLE

Web 2.0 integration requires a high level of learner-centered skills to develop a PLE (Lee, Miller, & Newnham, 2008; Weller, 2007) that will engage learners to create and manage their people network, resources network, and tools network. In educational and learning context, social network tools were considered as peer-to-peer learning technologies that afford learners to take control of their learning technologies (Liber, 2000). Siemens (2007) perceived that PLE was a collection of tools brought together under the conceptual notion of openness, interoperability, and learner control. PLE has been recognized as a meta-cognitive tool that could facilitate and deepen self-regulated learning and reflection (Tur, Marín, Moreno, Gallardo, & Urbina, 2016). Therefore, learners are required to apply a personal customized portal to organize multiple technology tools in one central location, such as personal or mobile portals.

## PLE Importance

Although PLE may appear as tool-, technology-, or platform-driven environments, it requires effective techno-pedagogical designs (Fournier & Kop, 2015; Saz, Engel, & Coll, 2016), competencies (Dabbagh & Fake, 2017), and self-regulated learning skills (Vázquez-Cano, Martín-Monje, & Castrillo de Larreta-Azelain, 2016). Besides using PLE to access and search for online information, articulate information needs, and locate relevant information, an effective PLE includes organizing, planning, managing and personalizing resources. It is a type of experiential learning. Dabbagh and Fake (2017) concluded that competencies and skills are needed to create effective PLEs and the affordances of digital technologies are also needed to support PLE development. Vázquez-Cano et al. (2016) recognized that a PLE model is constituted of a student-centric approach, development of personal knowledge management strategies, and formation of self-regulated learning skills. Researchers have found effective PLE should be easy to use, open, dynamic, and provide socialization and collaboration features (Haworth, 2016; Sahin & Uluyol, 2016). PLE is incorporated in three dimensions: levels of initiative (Woolfolk, Winne, & Perry, 2000), sense of control (Hall, 2009) and self-reflection (Zimmerman, 1998).

## Levels of Initiative

Levels of initiative determines whether PLE learners are able to construct, manage, search, access, and utilize different tools, content, and people networks. Self-organization of flexible learning technologies is the key to the complex environment of education in PLE management (Johnson & Liber, 2008). Explicitly, Ivanova and Chatti (2010-2011) stated that PLE is a skill of initiatives and organization of self-controlled and self-directed learning. White (2013) called competent PLE learners as personal knowledge integrators. More specifically, PLE is an environment that connects knowledge management and learning management via a digital platform (Renon, 2012). In fact, initiating PLEs would empower students to learn in collaborative, participatory, and distributed methods (Lankshear, & Knobel, 2007). Sahin and Uluyol (2016) recognized that not all learners were able to construct and manage their PLEs constantly and effectively to reflect their learning needs. Armakolas, Mikroyannidis, Panagiotakopoulos, and Panousopoulou (2016) found that most

students are aware of the PLE concept and its advantages. However, their utilization mostly had the aim of access and sharing knowledge in learning, but constructing and managing it remained limited (Sahin & Uluyol, 2016), such as emailing, social networking, file sharing, video sharing, Internet searching, social encyclopedias, etc.

### **Sense of Control**

Learning in PLE becomes more decentralized, and personalized. The control is shifted from the educators and institutions to each individual learner and results in renegotiating their relationships in more egalitarian and progressive ways. In addition, Johnson, Prescott, and Lyon (2017) argued that PLE management is an advocacy for shifting the locus of control of learning technology from institutions to each individual learner. PLE enables more dynamic, unrestricted, and participatory discursive practices. This makes learning more adaptive and more learner-oriented rather than predictive (Carroll, Jenkins, Woodard, Kop, & Jenkins, 2012). Personalization and customization of PLE require PLE users to take control with competent self-regulated learning skills. Researchers (Chaves-Barboza, Trujillo-Torres, López-Núñez, & Sola-Martínez, 2017; Rahimi, van den Berg, & Veen, 2015) recognized that PLE management is related to self-regulated learning skills and students' control theories and concepts in learning affordances. Based on social cognition theory perspectives, learners are seen as self-organizing, proactive, self-reflecting, and self-regulating but not just as reactive organisms shaped by environmental forces or driven by inner impulses (Carlson, 2008). Importantly, if students did not find the technology or platform provided by their institutions useful, they are now in a position to bypass it in favor of their own personalized approach and preferred tools (Conole, de Laat, Dillon, & Darby, 2008). To empower learners in their learning, they should have more control in determining learning goals, structuring learning networks, and selecting relevant task strategies. In fact, an enhanced level of control was observed by instructors in using PLE platforms in different courses (Tomberg, Lannpere, Ley, & Normak, 2013).

### **Self-reflection**

Self-reflection on PLE management is a key process to effective PLE development (Galván-Fernández et al., 2017; Rahimi et al., 2015). It is a process in which students engage in self-judgement and self-reaction on their PLE building and organizing (Tur et al., 2016) to constantly manage, personalize, and evaluate their PLEs. Thus, learners' engagement in self-reflection on their PLEs is vital. Chaves-Barboza et al. (2017) observed that teachers suggest PLE instructions should be related to the use of digital tools and recording of reflections on the learning process, and establish relationships between learning management tools and cognitive and metacognitive processes. By constantly self-reflecting, learners negotiate, interpret, evaluate, and analyze rapid and complex digital messages and regularly choose to compose and produce communication in increasingly self-directed and socially connected ways to construct their PLE. Therefore, self-reflection serves to enhance each individual PLE understanding and improvements for subsequent learning integration (Rogers, 2001). More specifically, PLE management is a developmental process and reflective practice to enrich students learning journey (Oakley, Pegrum, & Johnson, 2014). Valtonen et al. (2012) concluded that reflecting on PLE management would increase awareness of students' learning methods and applied pedagogies. Tur et al. (2016) discerned that instructors need to empower learners to show the depth of reflections on their PLEs in order to adequately support self-regulated learning.

### **Relationships of Digital Lifelong Learning and PLE**

Digital lifelong learners' PLEs go beyond formal learning. With the capability to interconnect multiple people networks in one central location, learners can engage in multiple types of learning, formal, non-formal, and informal learning (Greller & Drachsler, 2012). Through different people networks, learners can reach more meaningful network resources for different types of learning. With

the integration of PLE, digital lifelong learning may be more open, personalized, flexible in access, curriculum, pedagogy and management for formal, non-formal, and informal learning.

The literature argues that PLE has the potential for developing formal, non-formal, and informal learning experiences (Anderson, 2006) to enable individual knowledge management and construction, and evolve into a social learning platform or system where knowledge is socially mediated (Dabbagh & Reo, 2011). PLE has been seen as a bridge to connect formal and informal contexts into one environment (Hermans, Kalz, & Koper, 2013), including recreational use of PLE (Nieto Moreno de Diezmas & Donarza Manzano, 2016). More specifically, Bartolomé and Cebrian-de-la-Serna (2017) observed that students broadened the use of these PLEs to other subjects and non-formal learning situations. Turker and Zingel (2008) argued that PLEs could become effective pedagogical tools that influence students' cognitive processes in addition to serving as vehicles for lifelong learning. Marín Juarros, Salinas Ibáñez, and de Benito Crosetti (2014) indicated that to support informal and formal learning, PLE should be flexible and adaptable to the student's needs and preferences and, on the other hand, that academic tools might someday become personal tools. However, current literature lacks any empirical research study to address whether PLE supports all types of learning.

## **METHOD**

### **Participants**

One hundred and two Educational Technology master program students voluntarily participated in an online survey while they were taking various online courses in a southwestern American four-year public university. The demographic information of the participants is listed in Table 1. Overall, the majority of the participants were female ( $n = 74$ , 72.55%), Caucasian American ( $n = 70$ , 68.63%), and aged from 26 to 35 years old ( $n = 53$ , 51.96%).

### **Measurement of Research Variables**

The online survey, the Personal Environment Learning (PLE) Survey, was revised from the Online Self-Regulated Learning Questionnaire (OSLQ) (Barnard-Brak, Lan, & Paton, 2010) to reflect the emerging, complicated, and multiple learning platforms. The OSLQ was chosen as the template of the survey in the study because of its psychometric properties. In the validation study of the OSLQ (Barnard-Brak et al., 2010), the Cronbach alpha coefficients were .90 and .92 in two different validation samples: the Cronbach's alpha coefficients for each subscale of the OSLQ ranged from .85 to .92 in the first validation sample and from .88 to .95 in the second validation sample. All the Cronbach's coefficients were higher than the cutoff value of .70 (Nunnally, 1978) for an acceptable score reliability (i.e., internal consistency). The results from the same validation study also support the criterion validity of the survey.

### **Predictor variables**

The predictor variables were a participant's (a) level of initiative, (b) sense of control, and (c) level of self-reflection in personal learning environment (PLE) management measured by the total scores from various numbers of items (see Table 2) on a seven-point Likert scale with one as strongly disagree and seven as strongly agree.

### **Criterion Variables**

The criterion variables were the extent to which participants used PLE to support their (1) formal learning, (2) non-formal learning, and (3) informal learning. They were measured by the scores on various items (see Table 3) on a seven-point Likert scale with one as strongly disagree and seven as strongly agree.

Table 1. Demographic information of participants (N = 102)

Variable	Frequency	Percent
Gender		
Male	28	27.45
Female	74	72.55
Ethnicity		
Caucasian	70	68.63
African American	1	.98
Latino	2	19.61
Asian & Pacific Islander	7	6.86
American Indian & Alaska Native	4	3.92
Age		
18 – 25	7	6.86
26 – 35	53	51.96
36 – 45	19	18.63
> 45	23	22.55

## DATA ANALYSIS

Data analyses were conducted with the IBM SPSS Statistics 21. Moreover, the alpha level was set at .05 for all significance tests.

### Linear Regression Analyses

Linear regression analyses (Cohen, Cohen, West, & Aiken, 2003; Norusis, 2012) were conducted to assess the predictive relationship between one predictor variable and each of the criterion variables, respectively. In total, nine simple regression models were fitted to the data to address the research questions of interest.

### Significance Test

The one-tailed *t* test of the regression coefficient of a predictor was used to assess the linear predictive relationship between that particular predictor and a criterion variable (Cohen et al., 2003; Norusis, 2012). The null hypothesis in the one-tailed *t* tests was set up as  $H_0: \beta = 0$ . On the other hand, the alternative hypothesis was set up as  $H_1: \beta > 0$  due to the expectation of the positive predictive relationships between research variables.

### Effect Size Index

In each simple regression model, the squared multiple correlation coefficient ( $R^2$ ) (Cohen et al., 2003; Norusis, 2012) was computed to estimate the proportion of variance in a criterion variable associated with, then predictable by, a predictor variable. Moreover, the adjusted squared multiple correlation coefficients (adjusted  $R^2$ ) were obtained to correct the positive bias of the sample squared multiple correlation coefficients and serve as a more accurate estimator of their population counterparts (Cohen et al., 2003).



Table 2. Online survey items measuring different predictor variables

Variable	Survey item
Level of initiative	I actively manage (Add; Delete; Move) my PLE (Symbaloo tiles, mobile apps, etc.).
	I actively manage (Set; Update) my personal learning goals with PLE (Symbaloo tiles, mobile apps, etc.).
	I actively share my PLE (Symbaloo tiles, mobile apps, etc.) with other users.
	I actively manage (Add; Delete; Move) my PLE (Symbaloo, mobile devices, etc.) tabs.
	I actively search for newer and more effective PLE (Symbaloo tiles, mobile apps, etc.).
	I actively access my PLE (Symbaloo tiles, mobile apps, etc.).
	I actively utilize my PLE (Symbaloo, mobile devices, etc.) to support my own learning.
	Sense of control
With PLE (Symbaloo, mobile devices, etc.), I feel that I take control of my own learning environment by managing different learning tools.	
Within PLE (Symbaloo, mobile devices, etc.), when faced with a problem I try to solve it myself.	
Within PLE (Symbaloo, mobile devices, etc.), I can make decisions and be responsible for my own learning.	
Within PLE (Symbaloo, mobile devices, etc.), if I want to achieve something, I work hard to get it.	
Within PLE (Symbaloo, mobile devices etc.), I consider different sides of an issue before making any decisions.	
I do not get discouraged when doing something on PLE (Symbaloo, mobile devices, etc.) that takes a long time to achieve results.	
Within PLE (Symbaloo, mobile devices, etc.), I can control my learning from anywhere at any time from any computing devices.	
Level of self-reflection	With PLE (Symbaloo, mobile devices, etc.), my performance control positively enhances my attention, affect, and monitoring of my learning action.
	I would like to use PLE (Symbaloo, mobile devices, etc.) to support my own teaching & learning in the future.
	Within PLE (Symbaloo, mobile devices, etc.), whenever something good happens to me, I feel it is because I've earned it.
	Within PLE (Symbaloo, mobile devices, etc.), I feel being in a position of leadership.
	With PLE (Symbaloo, mobile devices, etc.), I feel that I am empowered to create my own learning environment.
	With PLE (Symbaloo, mobile devices, etc.), I feel that I am empowered to create my own learning program
	With PLE (Symbaloo, mobile devices, etc.), I am positively motivated toward creating my own learning environment.
	With PLE (Symbaloo, mobile devices, etc.), I continuously reflect on my online learning after this course.

Table 3. Online survey items measuring different criterion variables

Variable	Survey item
Us of PLE to support formal learning	
	I use my PLE to support my “FORMAL” learning
	Formal learning is the learning that is formally recognized by educational institutions with credits or any other recognitions.
Us of PLE to support non-formal learning	
	I use my PLE to support my “NON-FORMAL” learning.
	Non-formal learning occurs in a formal learning environment but is not formally recognized. It typically involves workshops, community courses, interest-based courses, short courses, or conference style seminars.
Us of PLE to support informal learning	
	I use my PLE to support my “INFORMAL” learning.
	Informal learning takes place independent of instructor-led programs via books, self-study programs, performance support materials and systems, coaching, communities of practice, and expert directories.

## RESULTS

### Descriptive Statistics of the Research Variables

The descriptive statistics of the predictor variables are listed in Table 4. Overall, participants had higher levels of self-reflection and sense of control (average result per item around 5.00) but a lower level of initiative (average result per item as 3.88) in PLE management.

The descriptive statistics of the criterion variables are listed in Table 5. As a group, participants seemed to be similar in terms of the extent to which they used PLE to support three types of learning (i.e., formal learning, non-formal learning, and informal learning).

### Use of PLE to Support Formal Learning as the Criterion Variable

The *t* test results in regression analyses (see Table 6) supported the predictive utilities of all three aspect of PLE management (i.e., level of initiative, sense of control, and level of self-reflection) for the use of PLE to support formal learning. Furthermore, the signs of the related regression coefficients supported the theoretically expected positive linear relationships between each statistically significant predictor and the use of PLE to support formal learning.

The sizable values of the  $R^2$  and the adjusted  $R^2$ , ranging from .52 to .58, corroborated the conclusions from the aforementioned *t* test results and suggested strong predictive relationships (Cohen, 1988) among all three aspect of PLE management and the use of PLEs to support formal learning.

### Use of PLE to Support Non-formal Learning as the Criterion Variable

According to the *t* test results in regression analyses (see Table 7), all three aspect of PLE management (i.e., level of initiative, sense of control, and level of self-reflection) could predict the use of PLE

**Table 4. Descriptive statistics of the predictor variables (N =102)**

Variable	# of items	<i>M</i>	<i>M/# of items</i>	<i>Mdn</i>	<i>SD</i>	Minimum	Maximum
Level of initiative	7	27.15	3.88	30.00	13.62	7.00	49.00
Sense of control	9	44.59	4.95	46.00	15.17	9.00	63.00
Level of self-reflection	7	35.45	5.06	38.00	12.28	7.00	49.00

Note. Survey items were constructed with a 7-point Likert scale ranged from 1 as strongly disagree to 7 as strongly agree; *M/# of items*: Mean scores divided by the number of items measuring each predictor variables.

**Table 5. Descriptive statistics of the criterion variables (N =102)**

Variable	<i>M</i>	<i>Mdn</i>	<i>SD</i>	Minimum	Maximum
Use of PLE to support formal learning	5.01	5.00	1.99	1.00	7.00
Use of PLE to support non-formal learning	4.75	5.00	1.95	1.00	7.00
Use of PLE to support informal learning	4.84	5.00	1.98	1.00	7.00

Note. Survey items were constructed with a 7-point Likert scale ranged from 1 as strongly disagree to 7 as strongly agree

**Table 6. Three simple regression models with the use of PLE to support formal learning as the criterion variable**

Predictor variable	<i>B</i>	<i>t</i>	<i>df</i>	<i>R</i> <sup>2</sup>	<i>adj. R</i> <sup>2</sup>
Level of initiative	.11	11.73*	100	.58	.58
Sense of control	.01	10.69*	100	.53	.53
Level of self-reflection	.12	10.47*	100	.52	.52

Note. *B* = unstandardized regression coefficient; *t* = *t* one-tailed test statistic; *df* = degrees of freedom; *R*<sup>2</sup> = squared multiple correlation coefficient; *adj. R*<sup>2</sup> = adjusted squared multiple correlation coefficient; \* *p* < .05

to support non-formal learning. The above predictive relationships were positive as theoretically expected based on the actual signs of the related regression coefficients.

The actual values of the *R*<sup>2</sup> and the adjusted *R*<sup>2</sup> from .35 to .53 supported strong predictive relationships (Cohen, 1988) between all three aspect of PLE management and the use of PLEs to support non-formal learning.

### Use of PLE to Support Informal Learning as the Criterion Variable

The *t* test results in regression analyses (see Table 8) supported the positive predictive relationships between each aspect of the PLE management (i.e., level of initiative, sense of control, and level of self-reflection) and the use of PLE to support informal learning.

The values of the *R*<sup>2</sup> and the adjusted *R*<sup>2</sup>, ranging from .40 to .55, indicated strong predictive relationships between three aspects of PLE management and the use of PLEs to support informal learning.

## DISCUSSIONS

This study concluded that each aspect of PLE management (i.e., level of initiative, sense of control, and level of self-reflection) was predictive of each type of learning (i.e., formal learning, non-formal

**Table 7. Three simple regression models with the use of ple to support non-formal learning as the criterion variable**

Predictor variable	<i>B</i>	<i>t</i>	<i>df</i>	<i>R</i> <sup>2</sup>	<i>adj. R</i> <sup>2</sup>
Level of initiative	.10	10.70*	100	.53	.53
Sense of control	.08	7.41*	100	.35	.35
Level of self-reflection	.10	7.57*	100	.36	.36

Note. *B* = unstandardized regression coefficient; *t* = *t* one-tailed test statistic; *df* = degrees of freedom; *R*<sup>2</sup> = squared multiple correlation coefficient; *adj. R*<sup>2</sup> = adjusted squared multiple correlation coefficient; \* *p* < .05

**Table 8. Three simple regression models with the use of PLE to support informal learning as the criterion variable**

Predictor variable	<i>B</i>	<i>t</i>	<i>df</i>	<i>R</i> <sup>2</sup>	<i>adj. R</i> <sup>2</sup>
Level of initiative	.11	11.11*	100	.55	.55
Sense of control	.08	8.30*	100	.41	.40
Level of self-reflection	.11	8.60*	100	.43	.42

Note. *B* = unstandardized regression coefficient; *t* = *t* one-tailed test statistic; *df* = degrees of freedom; *R*<sup>2</sup> = squared multiple correlation coefficient; *adj. R*<sup>2</sup> = adjusted squared multiple correlation coefficient; \* *p* < .05

learning, and informal learning). Furthermore, PLE management was most predictive of the use of PLE to support formal learning relative to the other two types of learning. The findings indicate the importance of applying PLE management to support digital lifelong learning. They also suggest that PLE is more than a technological platform but a new digital literacy to be taught; digital lifelong learners need to obtain PLE management skills.

### More than a Technological Platform

PLE is more than a technological platform. In fact, it is a conceptual space, pedagogical process, and digital networks that enable and support learners to achieve their lifelong learning goals. Attwell (2007) argued that PLEs play an important role in advancing the understanding of digital lifelong learning. PLEs can be perceived and integrated by learners to organize their own learning in multiple contexts where formal, non-formal, and informal learning support and complement one another. In PLEs, there is a symbiotic interdependent relationship among formal, non-formal, and informal learning. Cross (2007) conceptualized them as “ranges along a continuum of learning” (p. 16) either–or dichotomies.

Learning that resides in an organic environment is more than just a scheme. PLE would be more effective to lifelong learning if learners conceive understanding its response to many of the constant changes seen in society, which are facilitated by the open and social media (Weller, 2009). Effective implementation of PLE would shape technical, instrumental, and sociological aspects of digital lifelong learning. In other words, PLEs’ learning impacts and effectiveness should fall in between the technological and the sociological (Selwyn et al., 2012) rather than on either one because PLE is a living, learning environment. Therefore, formal, non-formal, and informal learning should be interconnected and interrelated to optimize it, understanding that learning is most effective when the learner engages in lifelong learning activities (Hall, 2009). While Web 2.0 technologies seem to be scaling up students’ informal learning, PLEs can be considered as a promising pedagogical approach for the deliberate or intentional integration of all learning spaces (Dabbagh & Kistantas, 2012).

### Lack of PLE Management Skills

Not all learners have competent PLE management skills. It is significant to note that results indicated participants had higher level of self-reflection and sense of control in PLE management, with the average result per item around 5.00 out of a seven-point scale, with a lower level of initiative,

with 3.88 out of a seven-point scale. Although all three aspects of PLE management can predict each type of learning, participants did not organize PLEs initially to manage gadgets/tools/apps to meet the short-term and long-term learning goals. Level of initiative requires learners to engage in “externalization acts” to build and to organize their ideal environments on and with technologies. At the outset, building PLEs may not come naturally for learners, even though 63.73% of learners reported this was their first time to use PLE. Interestingly, more than half of learners who self-reported their knowledge (57.84%) and skills (58.82%) in PLE were at an intermediate or expert level. It would be wrong to assume that informing learners of the availability of PLE tools could result in effective PLE management. Instructing learners to build and to manage their PLE may possibly be implemented via formal, non-formal, and informal learning.

### **PLE: A New Literacy for Digital Lifelong Learning**

Building and managing effective PLEs should be seen as a new digital literacy for digital lifelong learning (Drexler, 2010; Hicks & Sinkinson, 2015; Nieto Moreno de Diezmas & Dondarza Manzano, 2016). PLE management literacy should be taught by network educators and via network institutions’ open and networked formal and non-formal learning instructions.

### **To Network Educational Institutions**

The pedagogy of PLE suggests that educational institutions could amalgamate open instructions and open tools with flexible curricula to offer diversified lifelong learning (formal, non-formal, and informal leaning) to build more adaptive and sustainable organizational network learning models. Educational institutions should envisage, theorize, and instantiate new places, spaces, and environments for digital lifelong learning to meet the distinctive personal and local solutions of global needs and challenges.

Bartow (2014) sees what is happening online as part of a social revolution – not a technical one – and passionately encourages educational leaders to innovate by creating more adaptive organizational models that enable open learning experiences, new ways, and new drives for assembling them into much more varied courses of learning. The adaptive organizational models must be sustainable and organic environments instead of being mechanical or technical learning systems. Learning environments may be insinuated as multiple communities that cross educational institutions and organizations and inspire active community-community interaction.

### **To Network Educators**

A new role for PLE educators is to be willing to take on the learner’s role to integrate open tools, to transfer the power, and to impart the control to network learners (Reinders, 2014), besides engaging in constant exchange of teaching and learning experiences within schools and institutional communities and environments. This critical aspect of this dramatic shift involves challenges of both how to teach and who of teaching (Saltmarsh & Sunderland-Smith, 2010).

Educators need to integrate open network learning environment (ONLE) as innovative pedagogy to nurture learners to build PLEs. ONLE is a digital environment that empowers learners to participate in creative endeavors, more progressive and participatory discursive practices, conduct social networking, organize and reorganize social contents, and manage social acts by connecting people, resources, and tools with the integration of social media tools to design environments that are totally transparent or open to public view (Tu, et al., 2012). The same architecture can be used to design the degree of openness users feel is necessary to the situation. Educators may transform their digital instructions by permitting more open access to learning resources, more open personalization and customization, and more open learning tools to reflect individual learning needs.

Educators could assist students in building their PLEs in the first week of instruction. It is critical to explain to students why building PLEs is relevant to their lifelong learning, besides engaging students in reflection and discussion of why they built their PLEs in certain ways, and how they intend to use

them. Also, educators need to remind students to organize and to reorganize their PLEs regularly to reflect their current learning needs. Furthermore, course instructions should be designed in an open sense, so students can apply their PLEs to connect and to complete their instruction requirements. Educators should encourage students to apply their PLEs for other courses, non-formal learning, and informal learning. Oakley et al. (2014) suggested e-Portfolio as an effective way to facilitate the seeding of personal learning networks that will support lifelong learning after graduation.

### **To Network Learners**

Competent digital lifelong learners are more like network learners than online learners. Network learners need to have ability and capability to build different networks within communities to form and to nurture their PLEs. Network learners should employ open social tools to personalize and connect/build their three networks (people, resources, and tools) for all types of learning within network educator's open network in their educational institutions' environments. Network learners must utilize network technology to build their PLEs to liberate themselves and challenge oppressive forces, such as dominant discourses, via more participating and democratic network learning technologies. Learners in more democratic learning environments are encouraged to negotiate, interpret, evaluate, and analyze rapid and complex digital resources; they regularly choose to compose and produce communication in increasingly self-directed and socially constructed ways. If learners are not clear about their learning goals and are uncertain of how to appropriate relevant technologies to achieve these goals, an effective PLE would not occur at all. Because PLEs are more than just technology, learners should focus on the PLEs' value in connecting people, tools, and resources. Clearly, PLE requires learners with competent self-regulatory skills.

### **FURTHER RESEARCH**

Future studies should focus on how to prepare competent digital lifelong learners. While informal learning is challenging for educational institutions and educators to prepare digital lifelong learners, they can prepare lifelong learners via open and networked curricula, pedagogies, and instructions to establish sustainable education, learning, and instructional models. Although PLE and ONLE can serve as strategies to facilitate digital lifelong learning with network learning literacy to fulfill social justice in digital learning, research should continue to examine additional applications, strategies, sustainable models, and policies. The MOOCs movement received mixed reaction from critics. However, it should be seen as another conceivable application to inspire digital lifelong learning with open and flexible instructions to gain desired skills and knowledge, particularly Connectivist MOOC (cMOOC) that allows learners to personalize and customize their learning goals, needs, and journeys. It is critical for educational researchers to continue investigating what digital lifelong learning means to all stakeholders, such as all levels of governments, educational institutions, educators, and learners.

### **CONCLUSION**

This study concluded that each aspect of PLE management is predictive of each type of lifelong learning. It indicates the importance of PLE management to digital lifelong learning. Learning is more than learning about content. The knowledge and skills in managing personal learning environments are as critical as learning content. Instructing PLE managing skills in formal learning situations is needed to ensure learners obtain competent PLE management skills so they can apply these skills for effective non-formal and informal learning. Simply providing Web 2.0 tools in the absence of effective PLE building and task scaffolding is inappropriate (Mayer, 2004). At the onset of instruction, educators could assess learners' PLE management skills and, based on those assessments, educators could create effective PLE instructions. The objective is to engage learners in building and managing their PLEs for their lifelong learning instruction and activities within their preferred formal, non-formal, or informal

learning format. Educational institutions should strategically design open curricula to prepare digital lifelong learners. More specifically, the skills of level of initiative and PLE organization should be overtly taught since not all learners hold such skills and understand their value.

Learning is for life; life is to learn. Learning is a lifelong journey. With open network concepts, digital lifelong learning is extended to all human beings to reach their lifelong-goal realizations. Network learning literacy is becoming a new living skill and knowledge for the modern citizen. This study points to the need for pedagogies in designing effective digital network learning to enable learners to improve and advance their PLE skills and knowledge. Open, network, and environment pedagogies are key concepts for lifelong learning. The OER movement challenges the construction of education, learners, and educators, and it disrupts teaching and learning. While OER is perceived as a solution for social justice in digital lifelong learning, PLE and ONLE are identified as key pedagogy and instructional strategies to empower learners and to deploy the freedom to choose to be and to obtain network learning literacy to become competent digital lifelong learners.

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