

The role of learner control and psychological ownership for self-regulated learning in technology-enhanced learning designs. Differences in e-portfolio use in higher education study programs in Germany and Spain.

Ilona Buchem¹, Gemma Tur², Tobias Hoeltherhof³

¹Beuth University of Applied Sciences, Luxemburger Str. 10, 13353 Berlin, Germany, {buchem1}@beuth-hochschule.de

²University of the Balearic Islands, C/ del Calvari, 1, 07800 Eivissa, Spain

³Catholic University of Applied Science NRW, Wörthstr. 10, 50668 Cologne, Germany

Abstract. Theory and research show that psychological ownership has an important impact on how individuals engage, react to change and invest themselves into activities. Drawing on the theory of psychological ownership and self-regulated learning, this study explores the role of psychological ownership for self-regulated learning in context of technology-enhanced learning in four courses at two universities in Germany and Spain. We employ a research model which explains the route from perceived control of the learning environment to psychological ownership and from psychological ownership to self-regulated learning, drawing on previous research in Personal Learning Environments. We examine differences in learning designs and explore how these may be related to different perceptions of control and ownership. This study helps to apply and extend the theory of psychological ownership to the field of technology-enhanced learning with focus on e-portfolio practices in higher education while providing practical insights for creating and implementing learning designs which promote learner control, ownership and self-regulated learning.

Keywords: psychological ownership, learner control, self-regulated learning, e-portfolios, technology-enhanced learning.

1 Introduction

Psychological ownership as a cognitive-affective concept related to the state of feeling an owner of a specific “target”, which can be defined as any object of attachment [1], was developed in the organisational context and confirmed through multiple research as a positive resource for impacting human performance in organizations, e. g. employee attitudes, leadership, job satisfaction and job design [2],[3], [4], [5], [6]. Scholars have proposed that psychological ownership emerges because it satisfies three basic human motives, i. e. self-enhancement (i. e. a desire to achieve and maintain high levels of self-esteem), self-continuity (i. e. a desire to maintain stability of own self over time and across situations), and sense of control (i. e. a desire to maintain and demonstrate control) [7]. In recent years, the theory of psychological ownership has been extended

to other fields such as education [9]. The model of psychological ownership has been applied and tested in healthcare [7], usability design [8], technology-enhanced learning [9], use of social media [10], IT acceptance [11] and appropriation of technology [12], consumer behaviour related to touch-based interfaces [13], virtual communities [14] and in marketing [15].

A number of authors addressed the links between psychological ownership and other constructs including self-identity, well-being, self-adjustment, organizational accountability, sense of belonging, association with organization and organisational citizenship [2], [4]. Psychological ownership has been viewed as a positive resource for impacting attitudes (e. g. higher commitment, responsibility), self-esteem, self-efficacy, motivation, accountability, performance, sense of belongingness and self-identity [2], [4], [6]. The results from a number of studies conducted in organizations demonstrate positive links between psychological ownership towards the organization and employee attitudes, such as organizational commitment, job satisfaction and organization-based self-esteem, as well as work positive behaviour, such as improved performance and organizational citizenship [2], [3], [4]. Studies in virtual communities have shown that psychological ownership increases satisfaction, self-esteem, and contribution quality [14]. Research on IT acceptance have shown that psychological ownership mediates the influence of user participation on technology acceptance, especially perceived usefulness and perceived ease of use [11].

However, despite the vast literature, only a few authors have explored the concept of psychological ownership in context of technology-enhanced learning (TEL) and especially in relation to self-regulated learning in TEL [9], [16]. The study presented in this paper aims to advance current research on psychological ownership in context of technology-enhanced learning by focusing on the role of self-regulated learning (SRL). In this paper we explore the role of psychological ownership for self-regulated learning in context of learning in technology-enhanced learning environments. To test the model, a set of three sub-scales was developed and used to measure perceived control, psychological ownership and self-regulated learning as three components of the research model. The results are based on the data from an empirical study conducted in 2018-2019 with altogether 181 students, encompassing four cohorts of students from four different bachelor and master programs at two universities in Berlin, Germany (two groups) and in Ibiza, Spain (two groups). The study builds on previous research on psychological ownership in Personal Learning Environments (PLE) as a field in TEL [9], [16], and on the role of control in PLE design [17].

The remainder of this paper consists of the following parts: Section two begins with theoretical background on psychological ownership and self-regulated learning in context of TEL including some key insights from the review of previous research studies on psychological ownership and SRL. Section three consists of the research model tested in the study. Section four describes the study method and data collection. Section five presents the summary of research research and the final section includes the discussion and recommendations for future research.

2 Theoretical Background

The theory of psychological ownership was initially developed in context of organisation management, but there is also more recent research that has applied the concept of psychological ownership to virtual environments as specific organisations [14]. In previous research stages, the authors of this paper already suggested that psychological ownership has important implications for learning [16] and can be highly influenced by beliefs and other motivational, cognitive and behavioural characteristics, as supported by many educational frameworks such as the self-regulated learning model. Although it may seem that psychological ownership has specially been explored in relation to tangible objects, there is research that relates the sense of psychological ownership towards non-physical elements and in both cases psychological ownership as a feeling of property can have consequences leading to positive or negative effects on the individual [2].

2.1 Control as the Route to Psychological Ownership

Learner control has been a key research theme in TEL since early ages. During the two decades from 1980 to the late 1990's, learner control was mainly about instructional-delivery systems, computer-assisted programs or tutoring-based intelligent systems. Thus, the main learning aim was about designing diverse learning-paths based on individual choices of learners [18], [19]. In this case, the learning design provided control within a pre-defined range of solutions such as: control of sequencing exercises or content, control of pacing the presentation of content, control of displaying and viewing a selection of materials and activities and control of support and feedback from the system [20], [21], [22], [23].

More recently, research carried out from a more socio-constructivist perspective along with the uptake of Personal Learning Environments (PLE) placed focus on learner control through a more open and authentic design of learning environments and processes. In the literature review carried out in context of PLEs by [17], control was conceptualised in relation to different elements of the extended Activity Theory (AT) framework [40]. Control was conceptualised in five dimensions, i. e. control of objectives, control of tools, control of rules, control of social base and control of tasks [17]. In this sense control in PLEs was understood as giving students the capability to set their aims, adapting the tools needed to achieve them, selecting the task strategies, the social relationships for learning along with adopting the rules for learning and interaction, which is a broader approach to learner control compared to the development of learning systems in early stages of research [16].

In the context of e-portfolios, ownership was observed to be crucial for reflection as an important part of e-portfolio work [25]. [26] observed that control was an important variable for students and teachers to feel the ownership of their e-portfolio. In general, what seems to be particularly relevant and interesting in context of psychological ownership in TEL is the differentiation of psychological ownership for tangible and intangible targets as proposed by [9]. The study by [16] showed that perceived control and ownership of intangible elements of PLEs and e-portfolios (e. g. access and data) may

have stronger impact on learning than perceived control and ownership of tangible elements (e. g. tools).

2.2 Dimensions of Psychological Ownership

Psychological ownership was defined as “as that state where an individual feels as though the target of ownership or a piece of that target is ‘theirs’ (i. e. It is MINE!)” [2, p. 299]. As [17] pointed out, the perception of “owning” of a personal learning environment can be perceived on various levels, including technical (e. g. These are “my” tools.), legal (e. g. This is “my” data.) or affective (e. g. “I feel as owner.”). Furthermore, psychological ownership has been conceptualised by different authors as a construct comprising of five dimensions, i. e. sense of responsibility, sense of self-identity, sense of belongingness, sense of accountability and self-efficacy [2], [3], [4], [5], [6]. These five dimensions were defined by [2] as follows:

1. Sense of responsibility. Possessions promote the sense of feeling responsible for the target which involves the protection and enhancement of the target which may be also related to limiting access to others.
2. Sense of self-identity. Owning has a symbolic meaning and can be understood as the expressions of the self.
3. Sense of accountability. Accountability involves the need to hold and be held accountable for our possessions.
4. Sense of self-efficacy. Self-efficacy is mainly related to the feeling of being able to reach goals and overcome difficulties, and is also related to pleasure.
5. Sense of belongingness. The sense of ownership involves feeling the need to possess a place, or inhabit a home, which in turn, when we feel inhabiting the target is transformed to becoming a part of own identity.

In context of TEL, the sense of self-identity has been explored in further research. Recently, [27] observed some affordances of social media for the need of self-identity. First, coming to know the self is a process of self-awareness developed through interaction with the environment, in which we learn about the world we live in while at the same time learning about ourselves. The freedom offered by the media to explore and interact with the online world is an opportunity to define self-identity through self-reflection. Also, digital content published online can enable users to describe own self-identity to others, which in turn can help in getting to know own self-identity through self-reflection based on reactions of other uses and peers.

Second, social media can be complementary regarding the need to communicate self-identity to others, which is shown through the collection and showcasing of objects. People show their self-identity through posting on social media and research has demonstrated that there are people who can better express themselves in online services than in the real world. Thirdly, there is the need to maintain self-identity over time, keeping an emotional link with past identity. Social media can be very helpful in this aspect by documenting and connecting memories. Although each social media service can be helpful in different aspects, all together, they can fulfil the psychological need related to self-identity [10]. Along with self-identity, in related research in management

and business contexts, the feeling of belongingness has also been explored as loyalty and intention of participation in virtual environments [14] whereas the sense of responsibility for online learning has been observed as paramount [27] and is highly connected to self-regulated learning.

2.3 Self-Regulated Learning

Self-regulated learning has been defined as an approach for “learning how to learn” [28], which is particularly needed to focus on students’ active role and ability to manage their learning in the open and flexible spaces brought by social media and PLEs in higher education [29]. Personal learning environments and self-regulated learning are in alignment when supporting the shift from institution to student-centred methodologies and finally towards autonomous learning [30], [31].

The self-regulated learning model by [32] has had a relevant uptake in the context of PLE practice and research and it is the reference model by most cited works on PLE and SRL following [33], i. e. [34] and [35]. The SRL model by Zimmerman is conceived as a cycle of three phases in which students prepare learning, execute and assess it, and the author argues it can be taught in contexts of social learning but it is necessary for lifelong learning and informal contexts [48]. In each phase, students are “metacognitively, motivationally, and behaviorally” active to carry out a wide set of metacognitive tasks to achieve their aims [32]. In each phase, these tasks are also described into two sets of sub-phases: setting goals and strategic planning, and self-motivating for learning, which correspond to the forethought phase; self-control and execution of learning strategies along with metacognitive monitoring of learning for the performance phase; and, self-reflection which include metacognitive tasks for self-judgement and causal attribution for learning along with other personal reactive strategies to persist or avoid learning in further processes [32].

There is extensive research on SRL and the relationship among personal characteristics such as motivation and sense of responsibility, for which teachers have reported great difficulties as educational tradition has been based on rather passive roles [36]. When addressing autonomous learning in TEL, research has confirmed the positive impact of e-portfolio practices, see research by [37] on ePEARL and [38] on Mahara. Likewise, in the context of social media there is a wide variety of approaches from PLE approaches to usages of single social media services. [55] observed the development of performance and self-assessment tasks through the implementation of a PLE-based didactic strategy. The impact of diverse single social media services has been observed in terms of self-regulated aims from a wide variety of approaches: Virtual Learning Environments (e. g. Moodle) have been related to planning strategies [40] and motivation [41], which has also been particularly related to gamification tools [58]; blogs for reflective writing have been observed as a good didactic design to boost monitoring and reflection [59], and in particular blogs as e-portfolios have been related to SRL [60], [61]. In general, usages of social media have been reported in the three phases of SRL, during performance [43] and in particular on Twitter for planning and reflecting [47]. Likewise, in digital environments where e-portfolios have been addressed in native platforms, the impact on learning has been addressed in general terms, in particular observing reflecting processes [48].

However, these studies fail to explore and relate the metacognitive implications underpinning each process with control and sense of ownership by students towards their PLE. Previous research suggested that control and the sense of feeling identified could have an impact towards learning. In this current step, we aim to contribute with further knowledge on the nuances of this learning impact and we explore the SRL model. Furthermore, to extend knowledge on the ownership dimension, and building from previous work, we explore the concept of psychological ownership in context of TEL in terms of self-identity, responsibility and belongingness.

3 Research Model and Questions

Building on the research model used in previous studies by [9] and [16], the conceptual model presented in this study is based on the Antecedent-Consequences Model (ACM), in which psychological ownership (PO) is influenced by factors such as perceived control (antecedents) and leads to certain outcomes such as self-regulated learning (consequences). The AC model has been successfully applied in a number of empirical studies. We contribute with this new step of research by building from lessons learnt in previous work and exploring with greater depth some elements of the model such as psychological ownership itself and control of tangible and intangible elements. In the current study, psychological ownership is explored and measured in relation to three core dimensions based on previous research which showed that self-identity, sense of responsibility and sense of belongingness may have the major impact on learning in context of e-portfolio-based learning designs [16]. The consequences in the AC model are operationalised and measured in the current study in relation to self-regulated learning.

The research model shown in Table 1 builds on control of tangible and intangible elements (antecedents), measures psychological ownership in three dimensions (sense of responsibility, sense of self-identity, sense of belongingness), and self-regulated learning (consequences) in relation to the three stages of SRL model by [32], i. e. forethought, performance and self-reflection stages.

Table 1. Research model based on the Antecedent-Consequences Model (ACM) with Control as Antecedent and Self-Regulated Learning as Consequence of Psychological Ownership.

Control (Antecedent)	Psychological Ownership	SRL (Consequence)
Tangible elements	Self-identity	Forethought
Intangible elements	Responsibility	Performance
	Belongingness	Self-Reflection

Based on the theoretical approach described above and on insights from previous work [9], [16], [17], the current study is guided by the following research questions:

- How are control and psychological ownership perceived by learners in different e-portfolio-based learning designs?
- How is perceived control of tangible and intangible elements of the e-portfolio-based learning environment related to the sense of psychological ownership?
- What effects of psychological ownership, including self-identity, responsibility and belongingness, may be observed in relation to self-regulated learning?

The following section describes the method including data collection applied in the study to answer the research questions listed above.

4 Method and Data Collection

To test the proposed research model and hypothesis we applied a survey method and conducted a study based on the data obtained from altogether four surveys administered in the winter semester 2017/2018 and in the summer semester 2018 at the Beuth University of Applied Sciences Berlin (Germany), Department of Economics and Social Sciences and at the University of Balearic Islands (Spain), Department of Education. Data were obtained from 161 bachelor and master students who ranged in age from 18 to 40 years and were enrolled in four different program modules, all of which applied e-portfolios for support of learning and assessment. The subsections below describe the study sample, the research and learning design settings and the research instrument.

4.1. Study Sample

The primary sample for this study was a heterogeneous, multinational sample of 161 bachelor and master students from four different courses at universities in Berlin (two courses) and in Ibiza (two courses). The sample in Berlin encompassed altogether 81 bachelor and master students in two business programs, i. e. 72 students from the bachelor module “Foundations of Digital Media” in the Digital Business program (bachelor) and 9 students from the module “Information Management” in the Business Information Systems program (online bachelor). The sample in Ibiza encompassed 80 bachelor/master students in education programs, i. e. 64 students from the course “Educational Processes and Contexts” and 16 students from the course “Didactic Bases and Curriculum Design”. All students were enrolled in respective modules in the academic year 2017/2018. Students ranged in age from 18 to over 41 years with approx. 52% female and 43% male students in the Berlin sample and approx. 65% female and 35% in the Ibiza sample. The descriptive statistics related to the sample are summarised in Table 2 below.

Table 2. Study sample, n = 181 students (descriptive statistics).

Measures	Category	Frequency	Percent
Sample sizes	Berlin students (BSc)	72	44%
	Berlin students (BSc)	9	6%
	Ibiza students (MA)	64	40%
	Ibiza students (BA)	16	10%
National groups	German	81	50%
	Spanish	80	50%
Gender	Female	94	58%
	Male	63	39%
	Other	4	3%
Age	under 20	57	35%
	20-25	61	38%
	26-30	25	16%
	31-35	12	7%
	36-40	0	0%
	over 41	6	4%

4.2. Research and Learning Design Settings

Given the interests of researchers in perceived control and psychological ownership for self-regulated learning, the study in 2018/2019, similar to the previous studies in 2012 [9] and 201 [16], took place in higher education settings. Each of the participating courses applied e-portfolios as an important component of the learning design. In all cases, e-portfolios were used as methods and tools to support learning and assessment. Students in all four courses participating in the study were asked to use e-portfolios to support a range of learning outcomes, mainly related to documenting and presenting learning outcomes as part of assessment. Students created and developed their e-portfolios on their own and were allowed to take own decisions about interface design along with other decisions such as how, when and to whom to share the e-portfolio. Along with these options, students were allowed to address the learning tasks at hand from a wide range of approaches. Assessment in all courses was based on the e-portfolio. General indicators for assessment were introduced to students so they could meet expected quality criteria whereas feeling free to make decisions among a wide variety of options that were allowed under these general criteria. However, there were also some important differences in learning designs settings, which may be related to the results of the study. These included:

- National and cultural contexts with students from Germany and Spain
- Study fields, e. g. Business Programs vs. Teacher Education Programs
- Study programs, e. g. Bachelor vs. Master Programs
- E-portfolio technologies used to create e-portfolios, e. g. Blogger vs. Mahara
- E-portfolio activities including social media use vs. no social media use
- E-portfolio used in on-campus vs. online courses
- E-portfolio created by individuals vs. groups of students
- E-portfolio used as a prerequisite for exam vs. e-portfolio used as an exam
- E-portfolios used for processes (e. g. research) vs. presentation

The key features of e-portfolio-based learning designs in the four courses are summarised in Table 3 below.

Table 3. Learning design of the e-portfolio activity in participating program courses.

Study program	Learning design of the e-portfolio activity
Module: Information Management Program (BSc): Business Information Systems University: Beuth University o Berlin Sample n = 9 students	E-portfolio was used as a preliminary task in the course and prerequisite for admission to the final examination in this module. The e-portfolio activity was a group task, i. e. student groups created a joint group e-portfolio in Mahara and analyse a selected information system. The aim of the e-portfolio was to go beyond a lecture about information systems in theory and to give students an opportunity to work directly with information systems in practice and in groups. The e-portfolio method enabled students to become active in analysing and explaining a chosen information management system and presenting an example of an information management system in a sample company.
Module: Information Management Program (BSc): Business Information Systems University: Beuth University o Berlin Sample n = 9 students	E-portfolio was used as a preliminary task in the course and prerequisite for admission to the final examination in this module. The e-portfolio activity was a group task, i. e. student groups created a joint group e-portfolio in Mahara and analyse a selected information system. The aim of the e-portfolio was to go beyond a lecture about information systems in theory and to give students an opportunity to work directly with information systems in practice and in groups. The e-portfolio method enabled students to become active in analysing and explaining a chosen information management system and presenting an

	example of an information management system in a sample company.
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Module: Didactics & Curriculum Design	E-portfolio was a group-based learning task to document the construction process of knowledge as future teachers. At the end of the term, the final e-portfolio task was aimed at presenting their learning process and to reflect on learning achieved, changes done and new aims to establish. It was built on blogs (from Blogger), which were open, and students were encouraged to use social media services to construct e-portfolio artefacts. All platforms used for the e-portfolio tasks were social media services curated by students who owned their accounts. Students were allowed to design and develop their blogs and artefacts as preferred by editing templates and adding elements. They were free to decide their approach to the task while knowing the assessment criteria through a rubric. The e-portfolio task was mandatory and part of the subject assessment along with a final written exam. The e-portfolio was envisioned to support both digital and reflective skills.
Program (BA): Primary Education	
University: University of Balearic Islands	
Sample: n = 16 students	

Module: Educational Processes & Contexts	The design of the e-portfolio task was similar to the one in the BA program with two main differences. Their group e-portfolios were commented on by students on Twitter, where students created their individual accounts. The learning design included space for discussion among students who could own and use their microblogging services individually. Students were free to open their individual Twitter accounts and follow classmates and other in-service teachers and educational experts and institutions. As for assessment, the difference was that there was no final written exam. Thus, in the MA program the e-portfolio joined together the diverse tasks for the module in which students received a total average of the assessment.
Program (MA): Secondary Teacher Education	
University: University of Balearic Islands	
Sample: n = 64 students	

The differences in the e-portfolio-based learning designs outlined above may have affected the differences in learner control, psychological ownership and self-regulated learning as discussed in the sections below.

4.3. Research Instruments

The research employed a survey design based on the instrument used in previous studies conducted by in 2012 [9] and in 2014 [16]. The survey items were derived from research studies on perceived control [17], psychological ownership [3], [4] and [6] and self-regulated learning [32] and adjusted to the context of technology-enhanced learning, including e-portfolios, in higher education settings.

Based on the theoretical underpinning as described in the sections above, the conceptual model of the study encompassed three main groups of variables, i. e. (1) perceived control as a factor influencing psychological ownership, (2) psychological ownership as a factor influencing self-regulated learning, and (3) SRL influenced by perceived psychological ownership and indicating a certain quality of learning.

The instrument was first developed and implemented in the study by [9]. The sub-scale of Perceived Control (PC) was developed based on research results related to seven dimensions of control in technology-enhanced learning environments from the study by [17]. The sub-scale of Psychological Ownership (PO) was developed using a measure proposed by [4] and the extension by [6]. For the purpose of the study conducted in 2018/2019, the instrument was reexamined and extended in relation to the third part of the model, i. e. learning effects. The new instrument in 2018/2019 focused on self-regulated learning as a type of learning effects. The items for the SRL scale were drawn from the model by [48].

The survey encompassed altogether 36 items and respondents were required to indicate the extent to which they agree or disagree with the statements on a 5-point Likert-type scale (1 = strongly agree; 5 = strongly disagree). The instrument applied in the study in 2018/2019 was administered in the four study program courses as both paper-based surveys (Germany) and online surveys (Germany and Spain), using the same set of items for the three sub-scales. The surveys were translated into German and Spanish. Although the different administration methods (paper-based vs. online survey) and the translation of the items into two languages (German and Spanish) may have introduced a method effect, the researchers considered these modifications as necessary to ensure quality results. First, the paper-based method was used in Berlin to ensure high participation of students in the survey directly at the end of the course. Second, translation was used to help students in both countries (who were in their first semesters and not yet proficient in English) to understand the survey questions better in their own language. At the end all numeric results from the survey were aggregated to provide a full picture.

5 Results

In this section we summarise the results of the survey which encompassed the three sub-scales: (1) perceived control (PC), (2) psychological ownership (PO), and (3) self-regulated learning (SRL). The statistical analysis was conducted using R software environment for statistical computing.

5.1. Survey items

The measurement model was based on the Antecedents-Consequences-Model (ACM) with Perceived Control (PC) as antecedent of Psychological Ownership (PO) and Self-Regulated Learning (SRL) as consequence of PO. Table 4 shows the components of the three constructs (PC, PO, SRL) and the corresponding survey items.

Based on the model described above, the survey was created with 15 items for Psychological Ownership (PO), 5 items for Perceived Control (PC) and 16 items for Self-Regulated Learning (SRL), i. e. altogether 36 items. Respondents were asked to indicate the extent to which they agreed or disagreed with the series of 36 statements on a 5-point Likert-type scale (1 = strongly agree; 5 = strongly disagree). The results are presented in the sections below.

5.2. Test of sub-scales

Descriptive statistics and correlations were calculated for variables in each sub-scale. Table 5 presents the summary of Cronbach's alpha values (raw-alpha values) for each sub-scale. The results indicate high internal consistencies for each of the three sub-scales with the highest value of 0.95 reached for the Self-Regulated Learning (SRL):

Table 4. Components of the constructs and survey items used in the study.

Construct	Components and items
Psychological Ownership (PO)	<p>Sense of self-identity:</p> <p>1.1 I personally experience the successes and failures of the e-portfolio work as my successes and failures.</p> <p>1.2 I feel that by identifying with the characteristics of my e-portfolio it helps me develop a sense of who I am.</p> <p>1.3 I feel the need to be seen as a member of the group of students working with e-portfolio.</p> <p>1.4 It is important to me that others think highly of my e-portfolio.</p> <p>1.5 It is important to me to defend my e-portfolio to outsiders when it is criticised.</p> <p>1.6 I am proud to say to every person I meet that this is my e-portfolio.</p>

	Sense of belonging: 1.7 I think about my e-portfolio as MY e-portfolio. 1.8 I perceive myself to be psychologically intertwined with my e-portfolio. 1.9 I feel that my e-portfolio belongs to me. 1.10 I feel 'at home' with my e-portfolio.
	Sense of responsibility: 1.11 I accept full responsibility for my actions within my e-portfolio. 1.12 I accept ownership for the results of my decisions and actions in my e-portfolio. 1.13 I feel personally responsible for the work I do in my e-portfolio. 1.14 I feel I should personally take the credit or blame for the results of my e-portfolio. 1.15 I accept responsibility and take the consequences of these decisions in my e-portfolio work
Perceived Control (PO)	Tangible elements: 2.1 I could decide about and control the technical hardware (digital devices) I have been using to create my e-portfolio. 2.2 I could decide about and control the technical software (e-portfolio system) I have been using to create my e-portfolio. 2.3 I could decide about and control the data of my e-portfolio such as where is the data stored or who can access it.
Self-Regulated Learning (SRL)	Forethought phase: 3.1. I could set my goals 3.2. I could plan my learning path 3.3. I could realize and feel confident about my own efficacy 3.4. I could plan my learning outcomes 3.5. I could develop intrinsic motivation for learning 3.6. I could orientate my learning towards my learning goals Performance phase: 3.7. I could have an image of what I was learning 3.8. I could manage my own self-instruction 3.9. I could focus on my own learning 3.10. I could develop diverse task strategies 3.11. I could self-record my learning 3.12. I could self-experiment on my learning Self-reflection phase: 3.13. I could carry out my own self-evaluation 3.14. I could do causal attributions on my learning 3.15. I could feel self-satisfaction on my own learning 3.16. I could develop/avoid adapting my response to the new learning

Table 5. Summary of Cronbach's alpha values for three sub-scales.

Sub-scale	Cronbach's alpha (raw-alpha)
Psychological Ownership (PO)	0.92
Perceived Control (PC)	0.81
Self-Regulated Learning (SRL)	0.95
All three sub-scales	0.96

In general, the sub-scale Psychological Ownership (PO) reached slightly higher average values for all study groups (mean = 2.5, median = 2.4) compared to the Perceived Control (PC) (mean = 2.3, median = 2.2) and Self-Regulated Learning (mean = 2.4, median = 2.2) This indicates that perceived ownership was slightly higher than perceived control and self-regulated learning effects in the study sample. The comparison of values for the three sub-scales for the two national groups (Germany and Spain) shows that psychological ownership and perceived control were slightly higher in the Spanish groups compared to the German groups of students, but self-regulated learning was somewhat stronger in the German groups. These differences may be related to different learning designs as presented in Table 3. The discussion of the results is presented in the last section. Table 6 below summarises the description of sub-scales for the entire sample and the national groups.

Table 6. Description of scales. 5-point scale (1 strongly agrees; 5 strongly disagrees).

Sub-scale	Group	Min	Median	Mean	Max	SD
PO	all	1.133	2.400	2.489	5.000	0.7565251
PO	Germany	1.133	2.267	2.345	4.467	0.7530523
PO	Spain	1.267	2.467	2.635	5.000	0.7362027
PC	all	1.000	2.167	2.347	5.000	0.8757884
PC	Germany	1.000	2.000	2.078	4.333	0.7642564

PC	Spain	1.000	2.417	2.619	5.000	0.9017071
SRL	all	1.000	2.188	2.403	5.000	0.7651115
SRL	Germany	1.125	2.250	2.330	3.812	0.6371656
SRL	Spain	1.000	2.094	2.477	5.000	0.8738337

To graphically explore groups of numerical data for all three sub-scales, we used box plots for both groups as well as for the German and the Spanish groups of students. Figure 1 shows box plots of the corresponding numerical series.

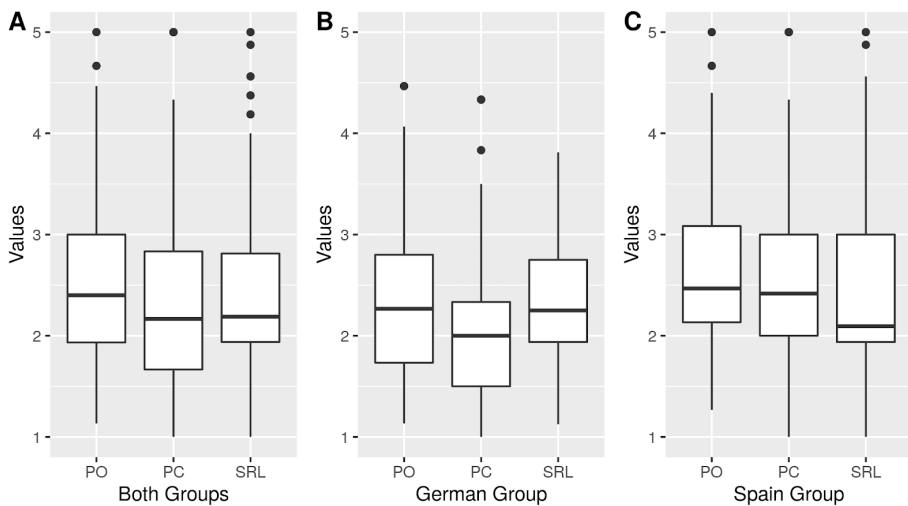


Fig. 1. Boxplots of sub-scales for both groups as well as for German and Spanish groups.

To analyse the differences between the sub-scales we used paired t-tests of sub-scales assuming that all variables are normally distributed. The p-values of less than .05 for the two pairs: (a) psychological ownership and perceived control, and (b) self-regulated learning and psychological ownership, show that the null hypothesis can be rejected and the means of sub-scales are different. The p-value of 0.2 for the pair (c) self-regulated learning and control, indicates a support for the null hypothesis. Table 7 summarises the results for the paired t-tests of sub-scales. The t-tests show the differences of the sub-scales PO and PC as well as SRL and PO. Assuming an Antecedents-Consequence-Model with PC as antecedent and SRL as consequence, this result is in

line with the research model as it underlines the independence of the sub-scales in the logic of the research model.

Table 7. Paired t-tests of sub-scales for both samples.

Sub-scale	t	mean of difference	p-value
PO and PC	2.8439	0.142236	0.005038
SRL and PO	-2.2457	-0.0860766	0.02609
SRL and PC	1.1468	0.05615942	0.2532

5.3. Comparing Sub-Scales and Groups

To further analyse and describe the interplay of perceived control, psychological ownership and self regulated learning, we related the sub-scales according to their learning design. Assuming that differences in the learning design somehow affect the way control influences ownership as well as ownership influences self regulated learning, a comparison of sub-scales uncovers characteristics of their correlations.

Figure 2 displays the correlation matrices of the sub-scales for the the entire sample as well as for German and Spanish groups. The correlation analysis is also in line with the research model, as it points out the relationships between PO, PC and SRL. In this way, the findings of inductive statistical analysis of the whole dataset are consistent with the research model and hereby underline a certain appropriateness of the PO-PC-SRL model.

However, as the visualisation in Figure 2 shows, there are particular differences between the correlations in the two national groups (Germany and Spain), which may be explained by the different learning designs. In general, the results show that correlations were stronger in the Spanish sample compared to the German sample. This may be a sign that within this particular learning design, learners perceived a higher ownership within the design and hereby also perceived a higher value of SRL.

Accordingly, the German learning design relies on Mahara as a single and consistent e-portfolio system for the whole groups, while the Spanish learning design focuses on using Weblogs and at the same time encourages students to use further social media services. These differences in learning design may shape a higher value of perceived control in the Spanish groups. A possible explanation could be that perceptions of control among students in the Spanish groups were higher, because students could choose to use or not to use different media.

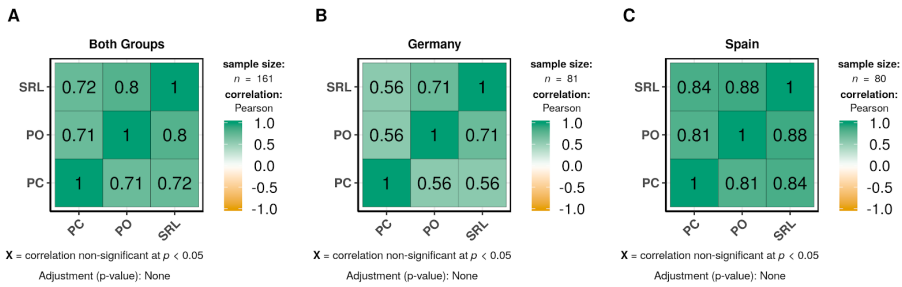


Fig. 2. Correlation matrices of sub-scales for both groups as well as for German and Spanish groups (all correlations are significant at $p < 0.001$).

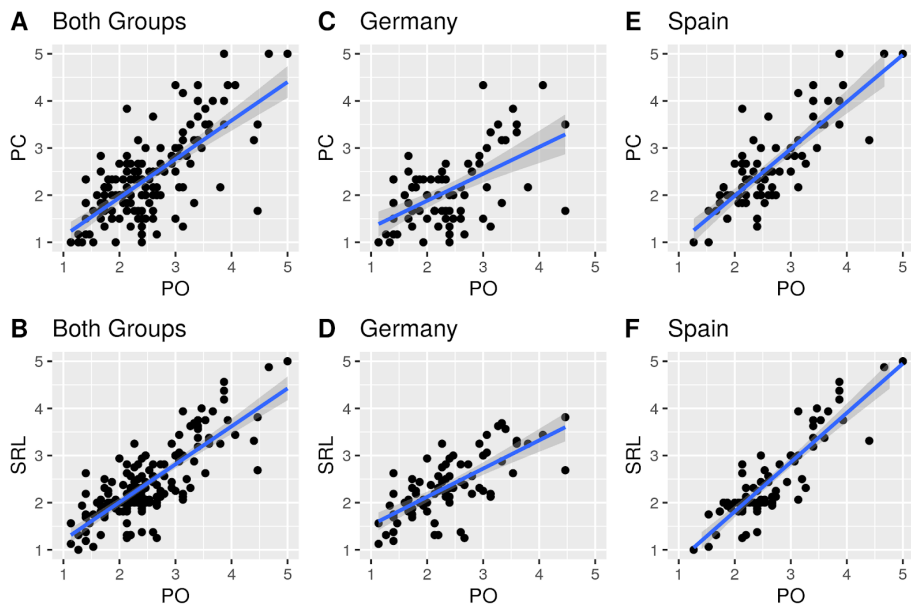


Fig. 3. Scatter Plots with correlation lines for both, German and Spanish groups.

The behaviour of item responses in the Spanish group appears to associate higher values on perceived control. Compared to the German group, means as well as maximum values are clearly higher. The higher spreading of PC responses in one group lead to a steeper gradient of correlation as well as to stronger correlation coefficients between the sub-scales PO and PC, because the spreading of PO responses are more comparable in both groups. This difference in response behaviour concerning perceived control may be explained by different learning designs in the German and Spain group. This explanation would underline the research model. However, as these effects occur within sub-groups in an international study, these effects may be also explained by a different item response behaviour in the Spain group compared to the German group. A possible explanation could be that Spanish students answer in a more enthusiastic

way than German students. Further research could explore such difference with the help of the Item Response Theory (IRT).

Figure 3 shows a more detailed view on the different spreading of sub-scales as well as on their interplay and connections within the groups. Drawing on a linear correlation model, the comparison unveils a steeper correlation gradient in the Spanish (E, F) sample compared to the German (D, C). This holds for the relation of PC and PO as well as for SRL and PO.

6 Discussion and Conclusions

This paper presented empirical research exploring the role of perceived control and psychological ownership for self-regulated learning in context of technology-enhanced learning in higher education. This research is a follow-up study to similar studies conducted in 2012 [9] and in 2014 [16]. The study shows that self-regulated learning is affected by psychological ownership and perceived control of the learning environment according to the Antecedent-Consequences-Model of psychological ownership proposed by [2], [3], [4], [5].

The common learning design approach in all study groups in Germany and Spain aimed at enhancing Self-Regulated Learning by giving students a certain degree of control of their e-portfolio-based learning activities by allowing for an individual documentation of learning and the focus on personal experiences and reflections through the learning. However, differences in learning design settings (e. g. national/cultural, technological such as Weblogs vs. Mahara and differences related to the use or non-use of Social Media such as Twitter) may be possible explanations for the differences in values and relations of the variables explored in the study, i. e. Perceived Control (PO), Psychological Ownership (PO) and Self-Regulated Learning (SRL). Further studies can explore differences in learning designs in a more systematic way, e. g. by employing experimental designs and using the ACM Model with the variables and items for PC-PO-SRL from this study.

However, as mentioned in the previous section, the reported effects and differences in t-values and correlations may be also explained by different item response behaviours in the two national groups. Therefore, further research could explore and analyse such difference with the help of Item Response Theory (IRT).

In general, the results of the study presented in this paper are in line with the research model and underline the appropriateness of the model. Nevertheless, further research studies are necessary to validate the research instrument with the proposed items with larger samples. Validation studies should also include international samples of students to explore possible national/cultural differences in item response behaviour.

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