



# Understanding the Role of Self-Regulated Learning in Academic Success. A Blended Learning Perspective in Vocational Education

*Comprender el papel del aprendizaje autorregulado en el éxito académico. Una perspectiva de aprendizaje combinado en la formación profesional*

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 Harun Cigdem

National Defence University, Turkey

hcigdem@gmail.com

 Semiral Oncu

Balikesir University, Turkey

semiral@gmail.com

## ABSTRACT

This study aimed to investigate the impact of self-regulated learning (SRL) skills on the academic success of non-commissioned officer (NCO) students within a Special Vocational College (SVC) belonging to the government context. As blended courses become increasingly prevalent, there is a growing interest in understanding the role of SRL, a critical determinant of academic performance. While SRL has garnered substantial attention in higher education, limited research has focused on its relevance within SVCs. Furthermore, little is known about the factors influencing students' SRL levels in online learning settings and their subsequent impact on course performance. Therefore, this study endeavors to identify the factors that influence SVC students' SRL and assess how it impacts success in blended courses. The study was conducted during the Fall semester of 2022-2023, encompassing five distinct compulsory blended courses and involving a total of 203 SVC students. We utilized a path model, expanding upon the framework proposed by Liaw and Huang in 2013, to assess the influence of SRL on academic achievement. The findings demonstrated that students' perceptions of the interactivity in the learning environment (ILE) and their perceived self-efficacy (PSE) had a positive and significant impact on their perceived satisfaction (PS). Additionally, ILE, PSE, and PS significantly influenced the perceived usefulness (PU) of the learning management system (LMS). Furthermore, ILE, PU, and PS emerged as significant predictors of students' SRL skills. However, the observed results did not entirely align with the expected impact on academic success. The study's findings shed light on the complex relationship between course achievement and SRL in blended learning settings, as well as the interrelated factors at play. The practical implications of these findings extend to how LMS administrators can support students in blended courses in becoming more self-regulated learners.

**KEYWORDS** self-regulated learning; achievement; vocational college; blended learning; interactivity; self-efficacy; satisfaction; post-secondary education.

## RESUMEN

Este estudio tenía como objetivo investigar el impacto de las habilidades de aprendizaje autorregulado (AA) en el éxito académico de los estudiantes suboficiales (LES) dentro de un Colegio Vocacional Especial (CVE) perteneciente al contexto gubernamental. A medida que los cursos mixtos se vuelven cada vez más frecuentes, hay un creciente interés en comprender el papel del AA, un determinante crítico del rendimiento académico. Si bien la SRL ha sido objeto de gran atención en la educación superior, la investigación se ha centrado poco en su relevancia dentro de los CVE. Además, poco se sabe acerca de los factores que influyen en los niveles de SRL de los estudiantes en entornos de aprendizaje en línea y su posterior impacto en el rendimiento del curso. Por lo tanto, este estudio se esfuerza por identificar los factores que influyen en la SRL de los estudiantes CVE y evaluar cómo afecta el éxito en los cursos mixtos. El estudio se llevó a cabo durante el semestre de otoño de 2022-2023, abarcando cinco cursos mixtos obligatorios distintos e involucrando a un total de 203 estudiantes del CVE. Utilizamos un modelo de trayectoria, ampliando el marco propuesto por Liaw y Huang en 2013, para evaluar la influencia de la AA en el rendimiento académico. Los resultados demostraron que las percepciones de los estudiantes sobre la interactividad en el entorno de aprendizaje (EEA) y su autoeficacia percibida (SAP) tuvieron un impacto positivo y significativo en su satisfacción percibida (SP). Además, la EEA, la SAP y la SP influyeron significativamente en la utilidad percibida (UP) del sistema de gestión del aprendizaje (SGA). Además, EEA, UP y SP resultaron ser predictores significativos de las habilidades AA de los estudiantes. Sin embargo, los resultados observados no coincidieron totalmente con el impacto esperado en el éxito académico. Los resultados del estudio arrojan luz sobre la compleja relación entre el rendimiento en el curso y la AA en entornos de aprendizaje mixto, así como los factores interrelacionados en juego. Las implicaciones prácticas de estos hallazgos se extienden a cómo los administradores del sistema de gestión del aprendizaje pueden apoyar a los estudiantes en cursos combinados para que se conviertan en aprendices más autorregulados.

**PALABRAS CLAVE** aprendizaje autorregulado; rendimiento; formación profesional; aprendizaje combinado; interactividad; autoeficacia; satisfacción; educación postsecundaria.

## 1. INTRODUCTION

E-learning applications that enable web-based learning have become dominant in the majority of educational activities — especially after Internet connection speeds have increased — and higher education bodies across the world have expanded the scope of the courses they offer using the blended learning (BL) approach (Cigdem, & Ozkan, 2022; Cigdem, & Ozturk, 2016; Jonker et al., 2018; Mestan, 2019; Moreno, 2019; Vera et al., 2019). BL arose as a new style of education at the turn of the 21st century, as e-learning activities began to support face-to-face education (Eggers et al., 2021). BL has become a well-known concept that can be applied to a variety of educational settings (Spanjers et al., 2015) and is widely accepted in post-secondary education (Allen et al., 2007).

BL is a pedagogical approach that integrates classroom activities with opportunities for socialization, which can be accomplished in person or through online presentation systems. In courses that follow the BL approach, students can more flexibly organize their working hours (Smith, & Hill, 2019), have more efficient discussions with the instructor and their classmates (Han, & Ellis, 2019), develop styles of learning of their own to compensate different styles of teaching of their instructors (Boelens et al., 2018), and participate more intensely in the course with the use of various learning materials (Mestan, 2019).

To promote a more flexible and student-centered approach to learning, BL combines traditional and online instructional methods. Some of the major current discussions about the BL approach recently involve the elements that affect how BL is utilized (Adekola et al., 2017) and students' self-regulation abilities as being one of these elements (Broadbent, 2017). BL supports the development of basic learning and reasoning skills by facilitating SRL and encouraging a deeper understanding of concepts, critical thinking, and the transfer of knowledge to practice (Dziuban et al., 2004; Osguthorpe, & Graham, 2003). Students' SRL characteristics have become more important thanks to the advent of electronic learning tools that enable students to learn on their own during extracurricular periods. Moreover, increasingly more research has highlighted the major role of self-regulation on how students perceive e-learning (Kramarski, & Gutman, 2006; Zimmerman, & Schunk, 2001).

Given the SRL premise, it is worth noting that the path model proposed by Liaw and Huang (2013) is one of the comprehensive models for estimating SRL from a variety of factors. They highlighted the importance of perceived usefulness (PU), perception of interactivity in learning environments (ILE), perceived satisfaction (PS), perceived anxiety (PA) and perceived self-efficacy (PSE) in understanding SRL, as well as the interrelationships among these elements. Their approach can serve as a useful baseline for predicting student achievement, which is the ultimate goal of education. A growing body of research has looked at the factors that influence student achievement in similar settings, none that we are aware of have attempted to predict achievement using the established model of Liaw and Huang (2013), particularly in blended learning environments. Our study will be the first to look into this situation. So, the goal of our research was to predict achievement based on the certain factors included and explained in the model of Liaw and Huang (2013) and extend their research by presenting its statistical significance, if any, in blended learning.

In addition to the extension of research that we explained above, another distinctive feature of our study is its unique setting in a Special Vocational College (SVC) belonging to the government. Unlike traditional colleges, SVCs are highly disciplined educational institutions with a specific focus on preparing students for specialized careers. This unique context presents several differences that set our research apart. Firstly, SVCs have a distinct educational mission, emphasizing not only academic excellence but also specialized training, leadership development, and character building. This dual focus creates a learning environment that is markedly different from that of traditional colleges, where the primary emphasis is on academic instruction. Secondly, the faculty members at SVCs are tasked with a unique challenge — they must deliver courses that not only meet academic standards but also align with the specialized curriculum and training requirements. This necessitates a tailored approach to teaching and learning that differs significantly from the methods employed in regular colleges. To address these distinctions and enhance the educational experience for SVC students, we implemented a blended learning (BL) approach, utilizing a Moodle-based course portal to complement face-to-face education. This approach was specifically tailored to the needs and demands of the SVC environment, taking into account the specialized curriculum and the importance of discipline and specialized training.

Liaw and Huang (2013) have already established in their model how certain factors relate to each other and SRL. We kindly ask the readers to refer to their study in that sense. What we provide next is the theoretical background on the hypotheses that perceived satisfaction, perceived usefulness, and SRL influence achievement in a significant way in the context of their model.

## 2. THEORETICAL BACKGROUND

In this study, we take the study of Liaw and Huang (2013) one step further by predicting student achievement in certain disciplines from perceived self-efficacy, perceived anxiety, interactivity in learning environments, perceived satisfaction and perceived SRL. A major modification was made on the relationships Liaw and Huang (2013) offered in their study. A link between perceived self-efficacy and SRL was established as we strongly believe that there is a theory-based direct association between the two constructs as explained below.

### 2.1. Perceived Self-Efficacy and Self-Regulated Learning

PSE is one of the strongest estimators of learner achievement (Bandura, 1978; Olivier et al., 2019; Opong-Gyebi et al., 2023; Schunk, 1991; Schunk, & DiBenedetto, 2016; Zimmerman et al., 1992) and is a favorable characteristic of effective learning (Liaw, & Huang, 2013). Therefore, a high level of PSE results in improved academic achievement and behavioral persistence in online learning settings (Chu, & Chu, 2010; Liaw & Huang, 2013). In this respect, students' attitudes towards learning, improvement of their skills, activity choices and motivation to continue learning are influenced by their PSEs.

Zimmerman and Schunk (1989) and Zimmerman (1990) define SRL as students' being "masters of their learning". It refers to students' capacity to formulate and periodically adjust their ideas, attitudes and behaviors to fulfill their educational objectives (Pintrich, 1995; Zimmerman, 1998, 2000). Gardner (1963) was perhaps the first person to come up with the idea of SRL in education. He acknowledged the importance of individual effort when learning something (Zimmerman, 1990). The educational system strives to give people the responsibility to sustain their personal learning tasks (Gardner, 1963). Since the sixties, SRL has been studied in different educational disciplines such as medical sciences, education, and cognitive science (Chitra et al., 2020; Cleary et al., 2020; Dignath, & Büttner, 2008).

Learners must have confidence in their ability to transfer what they have learned to a variety of settings; in other words, students must demonstrate strong PSE (Usher, & Pajares, 2008; Zimmerman, 1989; Zimmerman, & Pons, 1986). SRL, or learners' ability to utilize their competencies correctly and successfully, is linked to PSE, or their confidence in their capacity to complete an activity. Learners who have strong perceived self-efficacy and SRL skills can push themselves to learn new things (Bandura, 2006; Zimmerman et al., 2017). A strong sense of perceived self-efficacy positively affects SRL, resulting in stronger scholastic standards and ambitions, as well as a greater possibility of accomplishment. The feeling of accomplishment instilled in learners translates into increased confidence in their ability to thrive in school (Zimmerman, & Bandura, 1994; Zimmerman et al., 1992).

Even though perceived self-efficacy and SRL are significantly and positively correlated, self-regulation knowledge does not ensure effective implementation of self-regulation (Creer, 2000). Learners should also have confidence that they can attain their goals and reach their maximum potential by performing in line with their SRL skills. Therefore, people's faith in their ability to plan and carry out appropriate steps is essential for achieving desired results and is an inseparable part of how SRL occurs (Zeidner et al., 2000).

Excellence of schools has been the determinant of their students' educational progress; but, thanks to the Internet, students now have more individualistic authority over what and how they learn regardless of time or location. In this new age, knowledge construction is increasingly based on electronic inquiry, and in web-based educational research, students with strong perceived self-efficacy for SRL are those benefitting most from courses over the web (Debowski et al., 2001; Joo et al., 2000; Venkatesh, 2000). However, while it has already been shown that PSE affects effective learning (Honicke, & Broadbent, 2016) and SRL processes (Dent, & Koenka, 2016; Zimmerman et al., 1992) in general, there has been no study to date examining the impact of perceived self-efficacy on SRL and its indirect impact on academic achievement through SRL in courses designed using the BL approach.

Students should have the belief that the necessary skills can be attainable to achieve their academic goals. Once they have attained the skills, they should be capable of setting appropriate skills and trust that they can achieve their goals. This highlights the importance of PSE as an indispensable precursor of SRL. Therefore, this study also examined the possible path from perceived self-efficacy to SRL and academic success.

## 2.2. Perceived Usefulness and Achievement

Perceived usefulness is the degree to which individuals believe they will be using a particular system because they expect it to improve their performance (Davis, & Davis, 1989). In research, PU predicts course achievement and satisfaction for online learners (Johnson et al., 2008; Liaw, 2008; Miltiadou, & Savenye, 2003; Young Ju et al., 2012).

If students think that an e-learning system is useful for study, they are motivated to use it. In addition, if students are satisfied with an online learning system, their participation in learning processes can get better. As a result, students' use of such a system is influenced by how useful they find it and how satisfied they are with it (Liaw, 2008).

## 2.3. Perceived Satisfaction and Achievement

Satisfaction is defined as the fulfillment of a need with the help of an activity (Bolliger, & Erichsen, 2013). Satisfaction with a learning system is considered a key requirement for the effective administration of BL (Abou Naaj et al., 2012). A significant correlation has been reported between learner achievement and satisfaction with the online learning environment (Eom et al., 2006; Marks et al., 2005; Puziffero, 2008; Sun et al., 2008). Satisfaction has been identified to be one of the powerful predictors of many learning outcomes (Aghaei Sabet et al., 2022; Akyol, & Garrison, 2011; Bolliger, & Erichsen, 2013; Dziuban et al., 2015) Satisfied learners engage in less effort to learn, attend more BL courses, and recommend them to others (Abou Naaj et al., 2012). Academic success and course satisfaction can be considered as two complementary learning outcomes. This assertion is based on the well-established idea that when students are satisfied with their learning experiences, they are more likely to achieve positive academic outcomes. This relationship has been explored in numerous studies. For example, Miller (1977) and Pascarella and Terenzini (1991) found that student satisfaction with their educational experiences positively correlated with academic achievement. Additionally, Li (2022) discovered that there could be a possible relationship between perceived

satisfaction, learning behaviors, and academic achievement. Li's (2022) study revealed that individuals with higher online participation outperformed those with lower levels in terms of both learning scores and satisfaction. These findings align with our perspective on the interplay between course satisfaction, learning behaviors, and academic success. Derived from the results of the aforementioned research, the hypothesis that there is a strong link between satisfaction and achievement was tested in this study, extending the model proposed by Liaw and Huang (2013).

#### 2.4. Self-Regulated Learning and Achievement

Several studies (Bidjerano, & Dai, 2007; Joe et al., 2017; Pérez-González et al., 2022) have acknowledged the importance of SRL as an indicator of learner achievement in online systems. Few studies (Lin et al., 2016; Zhao, & Cao, 2023) have examined how learners' experiences of BL and their perceptions of BL environments affect SRL. To assist in understanding learners' attitudes regarding online learning, Liaw and Huang (2013) examined learners' SRL skills and proposed a theoretical framework to examine SRL skills in online learning settings. In their research, they found that perceived satisfaction, perceived usefulness and interactivity in learning environments factors predict students' self-regulation abilities when using e-learning environments. Hood et al. (2015) found that participant characteristics and roles in different groups in MOOC lessons affected their SRL skills and each dimension of SRL skills. MOOC students' age, gender, degree, and experience with online courses were important predictors of SRL, according to Li (2019).

Liaw and Huang (2013) examined the factors affecting learners' SRL skills in e-learning environments to try and understand student attitudes towards the whole e-learning process. Their findings suggest that interactivity in learning environments, perceived satisfaction of users and perceived usefulness of the ICT system are key variables needed to estimate how learners perceive their self-regulation in online learning settings. They concluded that perceived usefulness can be influenced by interactivity in learning environments, perceived self-efficacy and perceived satisfaction and that perceived satisfaction is closely linked to the perceived anxiety of users. In the model proposed by Liaw and Huang (2013), it was reported that perceived SR may be influenced by personal characteristics such as perceived self-efficacy and perceived anxiety, attitudes such as perceived satisfaction and perceived usefulness, and other factors including useful learning contexts such as interactivity in learning environments.

Research shows that a critical determinant of achievement is the learner's SRL skills (Anthonysamy et al., 2020; Zhu et al., 2016). Despite the advantages of the BL approach, success in this strategy is dependent on students' control of online learning processes, or self-regulation activities (Anthonysamy et al., 2020). To achieve satisfactory learning outcomes in any environment, learners must take the initiative to study, evaluate their learning needs, define learning goals, research educational resources, manage their time and learning setting, and implement useful techniques for learning (Rivers et al., 2022; Zhu et al., 2016). One of the challenges encountered in BL environments is students' learning processes (Boelens et al., 2017); that is to say, online learning is more challenging for undergrads because it requires greater learner participation and SRL, as well as enhanced learner control (Gedik et al., 2012; Zhu et al., 2016).

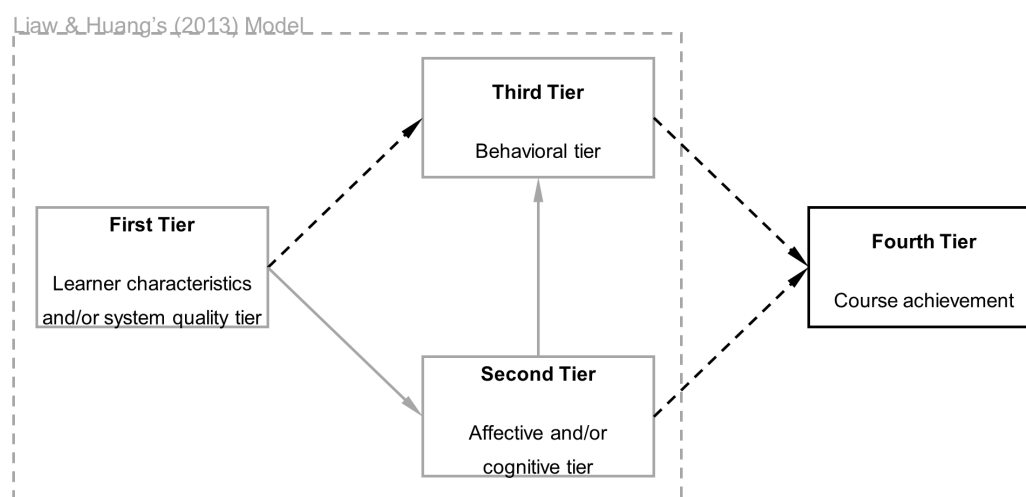
Given the online side of BL and the discussion above, it is reasonable to conclude that SRL has more to offer online learning than it does in regular classrooms (Rivers et al., 2022). Online environments demand

more autonomous thinking and participation from students (Broadbent, & Poon, 2015; Jansen et al., 2019; Littlejohn et al., 2016). Acquisition of SRL skills in online learning has undoubtedly become a requisite, especially because learners in higher education are expected to have SRL skills to independently pursue the academic goals they set (Anthony et al., 2020).

SRL is a key aspect in effective learning and has been extensively studied and widely used to explain the factors influencing success in e-learning research. In higher education, students with SRL skills have been found to achieve better learning outcomes (Barnard-Brak et al., 2010; Broadbent, & Poon, 2015; Cho, & Heron, 2015; Cho, & Shen, 2013; Greene et al., 2018; Hu, & Driscoll, 2013; Kauffman et al., 2011; Kizilcec et al., 2017; Paechter et al., 2010; Schunk, & Zimmerman, 1994; Tsai et al., 2011; Yukselturk, & Bulut, 2007). Given the importance of SRL, we propose that SRL, along with all of the related factors presented in the model of Liaw and Huang (2013), will effectively predict learning in BL environments and thus constitutes one of the primary goals of this study.

Based on the information addressed above, examining the elements that influence learner success through the online system they use on BL courses is a crucial undertaking not only to improve the use of the online system, but also to explain the influence of these possible factors. Based on the findings and recommendations proposed in the literature, this study was designed to reveal the associations among student achievement and select parameters such as SRL, perceived usefulness and perceived satisfaction in the courses delivered in a BL environment at a SVC (see Figure 1).

**FIGURE 1.** Theoretical framework of the study.



With the help of this study, researchers interested in online environments, BL approach and SRL can have a more comprehensive understanding of the factors affecting success in BL environments and design/offer better online systems and blended courses which can engage more audience and produce more effective learning results. Another significance of the study is related to the context of the study. SVCs can be seen as unique educational environments concerning the nature of communication among students and teachers due to certain authoritative standards. These standards instill in students discipline, time management, goal orientation, resilience and adaptability, which can positively influence their SRL behavior.

The structured learning environment of SVC makes an important contribution to our research by further developing students' ability to organize and self-regulate their work. Therefore, the use of the BL approach in lessons is a valuable opportunity to motivate students, increase their participation and improve their SRL skills. Since very little research is done in SVCs, our goal was to add to the literature and offer examples of comparable learning environments.

Based on both the literature and the model proposed by Liaw and Huang (2013), a theoretical path model was established to present hypothesized associations between perceived self-efficacy and SRL, as well as between the perceived usefulness, perceived satisfaction and SRL and course achievement variables. Figure 1 shows this model in general terms. The relationships shown in the model with one-way straight lines are taken from the study of Liaw and Huang (2013), and the relationships shown with the dashed lines represent the contributions of our research to the existing model. For example, the dashed arrow from the third tier to course achievement indicates that SRL is expected to affect course achievement. The goal of this study was to extend a research model for SRL in terms of the sustainability of the e-learning system at a SVC.

As previously discussed, the current study hypothesized the inclusion of new pathways as additions to the model examined by Liaw and Huang (2013). Specifically, hypothesis (1): interactivity in learning environments, perceived self-efficacy and perceived anxiety predict perceived satisfaction; hypothesis (2): perceived satisfaction, interactivity in learning environments and perceived self-efficacy predict perceived usefulness; hypothesis (3): interactivity in learning environments, perceived self-efficacy, perceived usefulness and perceived satisfaction predict SRL; and hypothesis (4): perceived usefulness, perceived satisfaction and SRL predict course achievement.

### 3. MATERIAL AND METHOD

#### 3.1. Design and procedure

This study was conducted at one of the SVCs in Turkey, which is a two-year college. Undergraduates are accepted to the college according to multi-stage selection criteria that include the national exam for entrance to university, followed by the school-specific physical exams and interviews. Candidates are given professional and technical training in addition to special preparation to become non-commissioned officers (NCOs). The school's courses use a BL approach, and an e-learning system called Course Portal, developed using Moodle to support face-to-face education.

The research was conducted within the scope of Information and Communication Technologies (ICT), English as a Foreign Language (EFL), Turkish Language, Mathematics and History courses, which are mandatory for all departments in the school. The courses' content was presented in the BL format, which included weekly face-to-face lessons over a 15-weeks period, as well as online presentations of the materials used in the face-to-face lessons to students via the Course Portal. During the face-to-face sessions, the students were taught the pre-planned content of the relevant week, and those who participated in the face-to-face sessions were able to review the materials through the Course Portal if they so desired. Students who were unable to attend or had difficulty understanding face-to-face courses were asked to review their lecture notes by logging into the Course Portal individually via an intranet.



In the online portion, the students were also given extra presentations, example project demonstrations, learning exercises, homework, and film clips through the Course Portal. Thanks to these features, the students could interact with the content and write to the instructor from any location and at any time on the university campus. Students had complete discretion over what they studied owing to the Course Portal.

### 3.2. Sample

The convenience sampling method was employed to choose the participants. Participants consisted of 203 freshmen SVC students who took the five mandatory courses mentioned above in Fall 2022 and filled the Learner Self-Regulation Scale (LSS) on a voluntary basis. Since the research context is an SVC, the fact that all of the participants were male university students living on campus makes the study different and also constitutes a disadvantage (related details are discussed under the heading Limitations).

### 3.3. Instrument

The data collection instrument was administered online through the Course Portal. All of the respondents were informed that their answers would be kept private and anonymized. The LSS tested by Liaw and Huang (2013) was used to determine SRL skills and their perceptions of the e-learning system. The Course Portal had been utilized to complement face-to-face education in all courses from the first week of school, and the LSS was administered in the third and fourth weeks of the fall semester, presuming that students had learned how to use the Course Portal in the first two weeks.

LSS consists of six dimensions and 30 items with 5-point Likert-type options that varied from 5 = "I strongly agree" to 1 = "I strongly disagree". The scale is focused on responses related to interactivity in learning environments, perceived self-efficacy, perceived anxiety, perceived satisfaction, perceived usefulness and SRL in relation to the online portion of the BL system.

The final grades of the five courses that the students took and were used in the study were taken from the student affairs information system. The final grades of the selected courses consist of the averages of the midterm exam held in the eighth week of the school term and the final exam in the 16th week.

### 3.4. Data Analysis

Data were exported from the Course Portal (School LMS) to a comma separated values (csv) format and then imported into and analyzed using the Statistical Package for the Social Sciences (SPSS) version 23 software and Analysis of Moment Structures (AMOS) version 23. P values smaller than .05 were considered statistically significant. Cronbach's  $\alpha$  statistics were used to analyze each dimension's internal consistency reliability.

To investigate the effects of the LSS dimensions on academic achievement, a conceptual path model was built using structural equation modeling as proposed in the literature. Our study did not have enough cases to run a full-scale SEM. Therefore, a path analysis was preferred using the mean scores of the variables in question.

### 3.5. Instrument Reliability

Reliability analyses were carried out to determine the internal consistency of the scale. The results are presented in Table 1. The overall Cronbach alpha coefficient for the scale is .919.

**TABLE 1.** Min, Max, Means, standard deviations, Cronbach’s alphas.

Variables	Min.	Max.	M	SD	Number of Items	Cronbach’s Alpha
<b>LSS Dimensions</b>						
PSE	1.00	5.00	3.86	.86	4	.87
PA	1.00	4.50	1.76	.78	4	.79
ILE	1.33	5.00	3.84	.67	6	.83
PS	1.20	5.00	4.14	.63	5	.86
PU	1.67	5.00	4.03	.68	6	.87
SRL	1.60	5.00	3.94	.66	5	.80
<b>Courses</b>						
ICT	2.00	96.00	50.03	24.39		
English	3.00	100.00	79.71	17.02		
Math	7.00	100.00	83.65	18.46		
Turkish	10.00	97.00	73.05	19.01		
History	10.00	97.00	71.71	19.74		

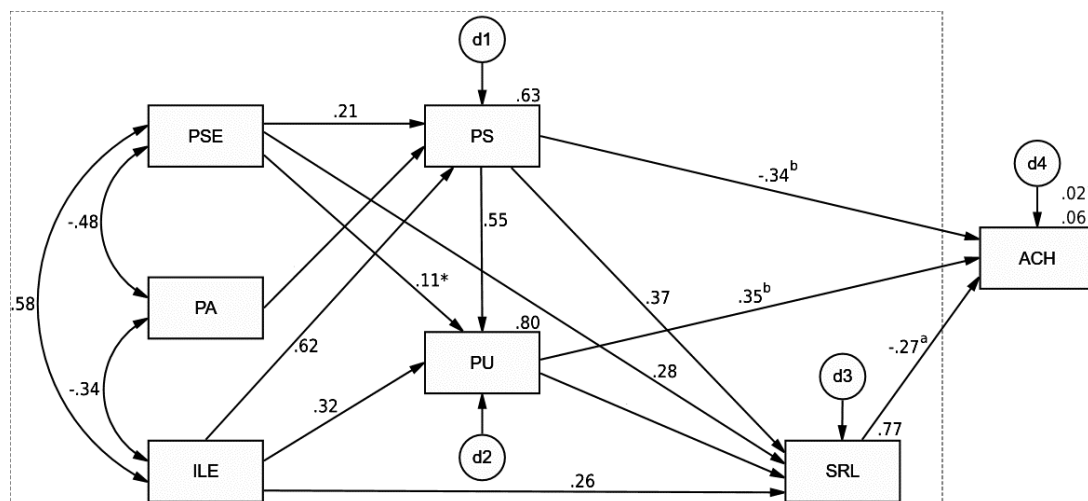
ICT: Information and Communication Technologies

A reliability score of .70 or greater is acceptable in simple research in social sciences (Cortina, 1993). According to reliability analyses, all dimensions have good internal consistency reliability. Descriptive statistics of all observed variables integrated into the path model (including course achievement scores) and reliability tests for each of the dimensions in LSS are also provided in Table 1.

## 4. RESULTS

Descriptive statistics (Table 1) show that the participants reported low PA (M = 1.76, SD = .78) and high PS (M = 4.14, SD = .63) and PU (M = 4.03, SD = .68). The course with the lowest GPA was ICT (M = 50.03, SD = 24.39). The representative path analysis for academic success is presented in Figure 2. The analysis was repeated for each of the five courses in which participants were enrolled. Our data successfully fit the model that we hypothesized (For ICT,  $\chi^2 = 7.414$ , GFI=.990, RMSA=.049, CFI=.997; for EFL,  $\chi^2 = 7.351$ , GFI=.990, RMSA=.048, CFI=.998; for Math,  $\chi^2 = 5.318$ , GFI=.993, RMSA=.018, CFI=1.00; for Turkish,  $\chi^2 = 7.129$ , GFI=.990, RMSA=.046, CFI=.998; for History,  $\chi^2 = 7.799$ , GFI=.989, RMSA=.053, CFI=.997).

**FIGURE 2.** The path model predicts achievement from SRL, PS, PU and indirect other variables.



ACH: Course achievement. a: Value applies to ICT, b: Value applies to EFL. Only significant values are shown. All path values are significant at  $p < .01$  except for \*, a, and b, which are significant at  $p < .05$ .

The primary interest as an outcome was course achievement (ACH), and summaries of the results of each path analysis are presented in Table 2. In terms of the significant paths that affected ACH, SRL has a significant negative influence on ICT Course achievement (-9.90). Similarly, perceived satisfaction has a significant negative influence on EFL Course achievement (-8.44). And PU has a significant positive effect on EFL Course achievement (9.34).

**TABLE 2.** Standardized and unstandardized regression weights of the path model for five different course achievement scores as outcomes.

Path	ICT		EFL		Math		Turkish		History	
	$\beta$	B	$\beta$	B	$\beta$	B	$\beta$	B	$\beta$	B
SRL → ACH	-0.27	-9.90 *	0.18	4.54	0.17	4.85	0.00	-0.11	-0.03	-0.91
PU → ACH	0.08	3.20	0.35	9.34 *	0.10	3.02	0.27	8.23	0.13	4.07
PS → ACH	0.15	5.46	-0.34	-8.44 *	-0.13	-3.44	-0.09	-2.46	-0.02	-0.55
PA → PS	-0.08	-0.07								
ILE → PS	0.62	0.63 **								
PSE → PS	0.21	0.16 **								
PSE → PU	0.11	0.08 *								
ILE → PU	0.32	0.30 **								
PS → PU	0.55	0.51 **								
PU → SRL	0.09	0.09								
PS → SRL	0.37	0.36 **								
PSE → SRL	0.28	0.21 **								
ILE → SRL	0.26	0.25 **								
PSE ↔ ILE	0.58	0.34 **								
PSE ↔ PA	-0.48	-0.32 **								
PA ↔ ILE	-0.34	-0.18 **								

ICT: Information and Communication Technologies, ACH: Course Achievement, \*significant at  $p < .05$ , \*\*significant at  $p < .01$

The secondary interest as an outcome was SRL. The greatest overall causal influence originated from PS (.37), followed by PSE (.28) and ILE (.26). Perceived usefulness had the lowest influence and did not contribute to the prediction of SRL (.09) ( $p > .05$ ). Our model explained approximately 77% of the variance in SRL.

Perceived usefulness was one other outcome of the model. The greatest overall causal influence originated from perceived satisfaction (.55), followed by ILE (.32) and PSE (.11). Our model explained approximately 80% of variance in PU.

Perceived satisfaction was an outcome variable, as well. The greatest overall causal influence originated from ILE (.62), followed by PSE (.21). Perceived anxiety had a negative influence and did not contribute to the prediction of PS (-.08) ( $p > .05$ ). And our model explained approximately 63% of variance in PS.

## 5. DISCUSSION

Descriptive statistics indicate that the participants' perceptions of the LSS dimensions are generally positive. LSS was administered at the beginning of the fall term in the 3rd and 4th weeks, and the participant perceptions were based on their first month of experience with the Course Portal as they were in their first year. Course grades consist of the results of the midterm exam in the 8th week and the final exam in the 16th week. The ICT course had the lowest grade point average, according to the calculations ( $M = 50.03$ ,  $SD = 24.39$ ). The fact that the course is taught in a hands-on way in computer laboratories, while the exams are theoretically done in the form of paper-based exams, maybe the most crucial factor for the low ICT course performance.

### 5.1. Hypothesis (1): ILE, PSE and PA Predict PS

In our study, perceived anxiety has a negative effect on perceived satisfaction, but this effect is not significant. While the negative trend is consistent with Liaw and Huang (2013), the non-significant effect means that perceived anxiety may not be a very important factor for predicting perceived satisfaction, at least in the context of our study. Our all-male, cadet sample may have had an effect on this, but this is speculation that needs to be explored.

Interactivity in learning environments and perceived self-efficacy have a significant positive relationship with PS. This finding is consistent with other studies (Cigdem, 2015; Liaw, & Huang, 2013) and means that perceived self-efficacy and interactivity in learning environments are important factors influencing learner satisfaction with the Course Portal. And in our study, interactivity in learning environments had a relatively greater effect on PS compared to perceived self-efficacy than that revealed by Liaw and Huang (2013). This has demonstrated even more strongly that making learning environments interactive can improve learner satisfaction.

### 5.2. Hypothesis (2): PS, ILE and PSE Predict Perceived Usefulness

Consistent with the model of Liaw and Huang (2013), it was found that perceived usefulness could be predicted from perceived satisfaction, interactivity in learning environments, and perceived self-efficacy. Therefore, hypothesis 1 was accepted. Other studies have shown the positive effect of perceived satisfaction

on perceived usefulness (Liaw, 2008) and perceived self-efficacy's positive effect on perceived usefulness (Sayaf et al., 2021; Teo, & Zhou, 2014; Venkatesh, 2000), and our model has consistently predicted the relevant variables. Considering our findings that are consistent with the link between interactivity in learning environments and perceived usefulness highlighted by Liaw and Huang (2013), interaction is a core aspect of all contemporary learning environments that may be strengthened with proper technologies and pedagogical techniques, as Cigdem and Öztürk (2016) points out. However, our study has also shown that the relationship between interactivity in learning environments and perceived usefulness is stronger than the estimate shown by Liaw and Huang (2013). Although their model has a bond between interactivity in learning environments and perceived usefulness about 2 times stronger than the bond between perceived self-efficacy and perceived usefulness (.20/.12, respectively), in our study this ratio is about 3 times (.32/.11, respectively). Based on this comparison, it is likely that the reason for the weaker relationship between perceived self-efficacy and perceived usefulness in our model is the direct link we hypothesize from perceived self-efficacy to SRL. Thus, while the indirect impact of perceived self-efficacy on SRL through perceived usefulness has been taken into account before, we have also envisaged a direct link in our model, and we were not wrong about it ( $\beta_{PSE \rightarrow SRL} = .28, p < .01$ ).

In general, the PU dimension has been shown to influence the perceived satisfaction dimension in the literature. Liaw and Huang (2013) also stated that they would consider the effect of perceived usefulness on perceived satisfaction in their study. However, in their final results, they presented the effect of perceived satisfaction on perceived usefulness. Since this study is based on their model, the path from perceived satisfaction to perceived usefulness was adhered to in our model.

### 5.3. Hypothesis (3): ILE, PSE, PU and PS Predict SRL

Except perceived usefulness, interactivity in learning environments, perceived self-efficacy and perceived satisfaction were all positive predictors of learners' SRL skills in our study. This finding is consistent with previous studies (Cigdem, 2015; Kramarski, & Gutman, 2006; Liaw, & Huang, 2013). It can be said that satisfied students, find the environment interactive and have self-efficacy in using the LMS have strong SRL skills. One of the key reasons for the strong perception of SRL appears to be blended courses' support for learning pace and offering students the flexibility to customize their learning.

Perceived usefulness, which is a part of this hypothesis, did not significantly predict SRL. This finding is inconsistent with past studies (Cigdem, 2015; Kramarski, & Gutman, 2006; Liaw, & Huang, 2013). We believe that the most important factor that causes this is the strong link between perceived self-efficacy and SRL. Our hypothesis that PSE has a significant relationship with SRL, which we predicted to extend the model proposed by Liaw and Huang (2013), was confirmed. We also found that students with strong PSE had strong SRL skills in our study, which is consistent with the literature (Dent, & Koenka, 2016; Usher, & Pajares, 2008; Zimmerman, 1989; Zimmerman et al., 1992; Zimmerman, & Pons, 1986). It is worthy to note that there is a similar direct link between interactivity in learning environments and SRL. These direct links seem to have minimized the indirect effects over the PU (from perceived self-efficacy, as well as interactivity in learning environments). In other words, students who are confident and think the system is interactive are better able to manage their behavior in the system regardless of whether they find the system useful or not.

#### 5.4. Hypothesis (4): PU, PS and SRL Predict Course Achievement

The test of our hypothesis that course achievement is directly and significantly affected by perceived usefulness, perceived satisfaction and SRL has revealed two different outcome scenarios concerning the ICT and EFL courses. There was no significant effect regarding the other courses.

We determined that SRL had a negative effect on the success in the ICT course. As discussed above, the fact that ICT is a practical course due to its nature, but that the exam is conducted theoretically (paper-based), may be an important reason for the negative effect. Despite the fact that the course space allocated for the ICT course on the Course Portal is rich in presentations, videos, and assignments for computer “applications,” the theoretical conduct of the exams for student performance evaluation may have caused students to experience a perception that was contradictory to their expectations. It would be useful to remember that the lowest mean achievement score belongs to ICT. Whoever thought that the system was optimal for self-regulation may have underestimated the ICT Course’s expectations.

In the EFL Course, a direct and positive link between perceived usefulness and achievement was found in line with previous studies (Johnson et al., 2008; Liaw, 2008; Miltiadou, & Savenye, 2003; Young Ju et al., 2012). However, contrary to the literature (Akyol, & Garrison, 2011; Bolliger, & Erichsen, 2013; Dziuban et al., 2015; Eom et al., 2006; Marks et al., 2005; Puziffero, 2008; Sun et al., 2008), a direct negative relationship was found between perceived satisfaction and achievement. The Course Portal space of the EFL Course contains many activities “for exam subjects.” We think that this is the reason for perceived usefulness’s significant and positive impact on course achievement. The negative and significant effect of perceived satisfaction on course achievement may be due to the fact that the scale was administered at the beginning of the school term and the students may have felt that they could not match the e-learning environment with the expectations of the course yet.

In the other courses, no significant relationship between LSS dimensions and course achievements was observed. The possible reasons for the incompatibility of this finding with many studies in the literature may be related to the environment and timing, such as the fact that the scale we used is for measuring SRL in online environments, the LSS was administered relatively early at the semester, and the students’ achievement status was determined in the sixteenth week. We anticipate that the results would differ if the scale was administered after the exam grades were determined. But a more likely speculation might be that SRL may not have similar effects on every course.

In this study, our aim was to evaluate the factors affecting achievement in terms of SRL by making an incremental contribution. As we mentioned above, the nature of each course may have affected achievement differently. Our aim was not to find and consider all the factors that could affect success but to examine the courses in their natural context non-intrusively. However, it is not possible to say that the SRL effect on achievement that we anticipate has occurred. Research that is also concerned with the nature of a course would, needless to say, necessitate the inclusion of more variables in the analysis as well as more experimental control of the learning environment. It was not possible to achieve this effectively with the sample and setting we had. As a goal, we can recommend that the way a course is delivered, its nature, be classified and included in analyses.

## 6. CONCLUSIONS

Our study contributes to the literature on two issues. First, it introduces a new model on predicting achievement in the context of SRL by extending the model of Liaw and Huang (2013). Our model offers specific, valuable, and interesting connections in predicting achievement for at least two different courses. Second, our study validates the learner self-regulation model of Liaw and Huang (2013) in the context of SVC students with minor differences.

Our research has a unique potential as it was carried out in a specific context of blended learning and on students at an SVC — who have received little research attention in comparison to other groups in the literature. When students are given the opportunity to use an LMS, if they find it interactive, have strong perceived self-efficacy and are satisfied with it, they may find it more useful. Perceived positive usefulness can positively affect use behavior.

In conclusion, LMS administrators may contribute to the long-term student success by creating useful, interactive environments for students and teaching newly enrolled students how to use the LMS, which can improve student's perceived self-efficacy and thus their use.

### 6.1. Limitations and future lines of research

There are some limitations to our study. Participants are limited to boarding students at an SVC, and the findings are limited to the context of a single university. The fact that all participants are male makes it challenging to generalize our results to ordinary university settings (however, it is also an advantage in that it shows the specific effect on males). In addition, in our study, the LSS was administered relatively early during the semester. As we discussed earlier, its implementation towards the end of the semester can contribute to the formation of more informed student perceptions of the interactive environment.

## 7. DECLARATIONS

### 7.1. Competing interests

The authors declare that they have no competing interests

### 7.2. Funding

This research did not receive any external funding.

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