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The Interplay of Autonomy, Self-Efficacy, and Learning Experiences in a Virtual ESP Course: Insights from Iranian Female Students

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ABSTRACT

Objective: The study aimed to examine the relationship between autonomy, self-efficacy, and learning experiences among female students enrolled in a virtual English for Specific Purposes (ESP) course at an Iranian university. It also sought to determine the extent to which autonomy and self-efficacy predict student engagement and academic success in an online learning environment.

Methods: A mixed-methods design was employed. Quantitative data were collected using standardized autonomy and self-efficacy questionnaires, while qualitative data were gathered through semi-structured interviews. The participants were fifteen female students aged 18–22, enrolled in the ESP course during the second semester of the 2023–2024 academic year.

Results: Quantitative findings showed strong positive correlations between autonomy, self-efficacy, and students' learning experiences. Both autonomy and self-efficacy emerged as significant predictors of engagement and academic success, with autonomy exerting the strongest influence. Qualitative findings further highlighted those higher levels of autonomy and self-efficacy enhanced motivation, participation, and perceived learning outcomes in the virtual learning environment.

Conclusions: The study concludes that autonomy and self-efficacy play crucial roles in shaping positive learning experiences and academic performance in online ESP courses. Enhancing these constructs through intentional curriculum design, instructor preparation, and supportive technological tools can significantly improve learner engagement and success in virtual education settings.

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Introduction

In language learning, the concept of autonomy has gained increasing attention, particularly in virtual environments where self-regulation is paramount. Benson (2013) defines autonomy as the ability to control one's learning process, which encompasses managing learning activities, cognitive processes, and selecting content. This model is integral to understanding how students engage with their learning, set goals, monitor progress, and evaluate outcomes in virtual contexts. Recent studies show that autonomy in virtual learning environments significantly enhances motivation and academic performance (Husnawadi, 2021; Faghihi & Chemelnezhad, 2021; Karimi & Abaszadeh, 2017; Kostka & Lockwood, 2015), aligning with findings that autonomous learners exhibit greater language proficiency and communicative skills (Yen & Liu, 2009).

Self-efficacy, a crucial factor in learning, refers to one's belief in their ability to successfully execute tasks and achieve goals (Bandura, 2001 as cited in Zahirinia, 2024). In language learning, self-efficacy has been positively correlated with proficiency and motivation (Magogwe & Oliver, 2007). Self-efficacy plays a significant role in virtual environments, where students often face unique challenges such as isolation and technical barriers. Studies suggest that self-efficacy helps students overcome these obstacles by boosting their persistence and willingness to engage (Allen & Seaman, 2012; Xiao, 2021).

The relationship between autonomy and self-efficacy is critical in virtual settings, where learners must demonstrate high levels of self-regulation and adaptability. Research suggests that self-efficacy amplifies the benefits of autonomy, as it fosters confidence and motivation in learners (Tilfarlioglu & Ciftci, 2011). Moreover, virtual platforms that support learner autonomy, such as those discussed by Rahimi and Zilka (2022), enable students to manage their learning processes effectively.

However, while these studies have explored autonomy and self-efficacy in general education contexts, their roles in virtual English for Specific Purposes (ESP) courses remain underexplored. ESP courses, which combine language learning with professional or academic content, present unique challenges, particularly in virtual environments. These courses require students to not only master specialized knowledge but also navigate digital platforms that demand self-regulation and confidence. The gap in the literature is thus evident: while autonomy and self-efficacy have been

studied in broader educational settings, their specific impact on ESP courses in virtual environments is yet to be fully explored.

This study seeks to fill this gap by examining the relationships between autonomy, self-efficacy, and learning experiences among female ESP students at Farhangian University in virtual settings. Understanding how these constructs interact in such specialized contexts is crucial for developing teaching strategies that support engagement and optimize learning outcomes in virtual ESP education.

By addressing this gap, the study aims to provide insights that can enhance the design and delivery of virtual ESP courses, particularly in terms of fostering autonomy and self-efficacy.

In light of the identified gap, the current study aims to address the following research questions:

1. Is there any relationship between autonomy and learning experiences in a virtual setting?
2. Is there any relationship between self-efficacy and learning experiences in a virtual setting?
3. How do students perceive the role of autonomy and self-efficacy in their learning experiences within a virtual setting?

Previous Studies

Han and Geng (2023) argue that the quality of student learning in technology-enhanced learning is influenced by their autonomy in using online technologies. Their study found that perceived instructional support positively impacts deeper engagement with technology, while autonomy facilitates more effective learning. Similarly, Ludwig and Tassinari (2023) highlight that online learning fosters greater learner autonomy, although this autonomy needs to be supported by teachers to be most effective. Susanti et al. (2023) reinforce this by showing that student autonomy in online learning is shaped by motivation and collaboration, with motivated students demonstrating greater responsibility for their learning.

However, the increased autonomy in virtual learning does not always guarantee success. Biwer et al. (2021) found that while some students thrived in autonomous learning environments during the pandemic, others struggled with self-regulation. This suggests that autonomy alone is insufficient without proper support. Pratiwi and Waluyo (2023) further emphasize the role of digital tools in fostering autonomy, finding that platforms like "Kahoot!" and "Quizizz" enhance learner autonomy and improve outcomes. However, they note that these tools must be effectively integrated into the learning process.

Self-efficacy significantly impacts students' engagement and success in virtual learning. Heo et al. (2021) report that self-efficacy in technology use negatively impacts learning engagement, but self-efficacy in time management positively influences both engagement and online self-efficacy. DeNoyelles et al. (2014) corroborate this, showing that higher self-efficacy in tasks, content, and environments correlates with better course outcomes in virtual settings. Likewise, Alemayehu and Chen (2023) find that self-efficacy enhances learning engagement and is partially mediated by self-monitoring and motivation, which also impacts course satisfaction.

The importance of self-efficacy in online learning is further supported by Pendergast et al. (2022), who found that virtual reality experiences boosted teacher education students' self-efficacy, fostering greater confidence in both technology use and pedagogy. Similarly, Prifti (2020) highlights the positive link between LMS self-efficacy and student satisfaction, indicating that technological confidence directly enhances learning experiences. Zheng and Xiao (2024) also demonstrate that online learning self-efficacy positively influences course satisfaction, with self-regulated learning acting as a mediator in this relationship.

The relationship between autonomy and self-efficacy is reciprocal and intertwined. Wang and Shan (2018) show that autonomy enhances self-efficacy by reducing learner anxiety and increasing engagement in collaborative tasks. Lowell and Tagare (2023) add that autonomy improves self-efficacy and learning transfer, leading to better learning outcomes. Yu et al. (2024) further explain that autonomy, combined with intrinsic motivation, reduces cognitive load and increases learning success.

However, the relationship is not straightforward. Zheng and Xiao (2024) highlight that self-regulated learning partially mediates the influence of self-efficacy on satisfaction, underscoring the need for both self-efficacy and regulation skills for optimal outcomes. This view is supported by Alemayehu and Chen (2023), who argue that self-monitoring is a key factor in bridging motivation, self-efficacy, and engagement in online learning environments.

Material and Methods

Design

The research design used in this study was descriptive-correlational and aimed to examine the relationships between autonomy, self-efficacy, and their influence on the educational experiences

of female students enrolled in an ESP course within a virtual learning environment. This design integrated both quantitative and qualitative methodologies to capture a better understanding of the subject matter. The mixed-methods approach allowed for a robust analysis, combining the statistical power of quantitative data with the depth of qualitative insights.

Participants

The participants in this study included 15 female students, aged between 18 and 22, enrolled at Farhangian University in Tehran. These students were selected from a larger cohort of 41 university students in Iran who were enrolled in ESP classes. The selection criteria were based on their enrollment in the ESP course and their willingness to participate in the study.

Instruments

Autonomy Questionnaire (AQ)

The AQ was developed in Persian to measure participants' learning autonomy. It was created through an extensive literature review on learner autonomy (e.g. Gholami, 2016; Hyland, 2004; Van Nguyen & Habók, 2021), focusing on key dimensions such as decision-making, protection, regulation, and problem-solving. Experts in educational psychology and language learning reviewed the initial items for content validity. After refining the items based on expert feedback, a pilot test was conducted with a small sample of students to evaluate clarity and reliability. This led to the final questionnaire with four subscales, each rated on a four-point Likert scale from "never" (1) to "always" (4). The internal consistency reliability was confirmed with Cronbach's alpha coefficients of 0.790 for decision-making, 0.800 for protection, 0.783 for regulation, 0.724 for problem-solving, and an overall alpha of 0.810, ensuring the instrument's validity and reliability.

Questionnaire of English Self-Efficacy (QESE)

We employed the QESE by Wang et al. (2014), adapting and translating it for our study. The original seven-point Likert scale was modified to a four-point scale from "never" (1) to "always" (4) to simplify responses and reduce central tendency bias. The questionnaire was translated into Persian and validated through back-translation and pilot testing with Persian-speaking students to ensure clarity and cultural relevance. Adjustments were made based on feedback, maintaining the reliability and validity of the original. The final Persian QESE showed excellent internal

consistency with a Cronbach's alpha of 0.95, confirming its reliability for assessing English self-efficacy among Persian-speaking participants.

Semi-Structured Interview

The semi-structured interview questions were developed based on a thorough review of the literature on autonomy and self-efficacy in virtual learning environments, with key influences from prior studies on learner engagement, motivation, and virtual education dynamics. The questions aimed to explore participants' sense of control, independence, confidence, and their perceptions of how these factors influenced their academic experiences, including motivation, engagement, and performance. Validation of the interview protocol was achieved through expert reviews by two educational psychologists and a pilot study with three participants, ensuring clarity, relevance, and alignment with the study's objectives. The final set of questions covered areas such as participants' perceptions of autonomy and self-efficacy, their interplay, and specific examples of how these attributes supported or hindered their virtual learning experiences.

Data Collection Procedure

Data collection for this study occurred in two phases, in the second semester of the academic year 2023-2024, from mid-April to late June 2024. First, questionnaires assessing English autonomy and self-efficacy were administered to the 15 participants. To facilitate the administration of questionnaires online, this study utilized Porsall, an Iranian platform designed for efficient and user-friendly data collection (https://porsall.com). Second, semi-structured interviews were conducted with the same 15 participants in Persian. Each interview, conducted in a virtual setting using Adobe Connect with participants' consent, lasted between 60 and 75 minutes. The interviews were audio-recorded and subsequently transcribed for analysis purposes. To ensure the study's reliability, interactive questioning techniques were employed during interviews to clarify any ambiguous or incomplete responses. Furthermore, interview transcripts were shared with participants for their review, approval, and comments, aiming to accurately represent their perspectives and strengthen the study's credibility.

Ethical Considerations

Ethical considerations were upheld by obtaining informed consent, ensuring voluntary participation, and safeguarding confidentiality through data anonymization. Participants were also

made aware of their right to withdraw from the study at any time without any negative consequences.

Data Analysis Procedure

The data analysis followed a structured approach to ensure reliable and accurate results. For the quantitative data, descriptive statistics (mean, standard deviation) were first calculated to summarize the general trends and variability. Cronbach's alpha was used to assess the reliability of the instruments, with values of 0.810 for the AQ and 0.95 for the QESE, indicating strong consistency. Next, Pearson correlation coefficients were calculated to examine the relationships between autonomy, self-efficacy, and students' educational experiences. To further explore these relationships, multiple regression analysis was carried out to determine the extent to which autonomy and self-efficacy predicted students' educational experiences in the virtual learning environment.

For the qualitative data, thematic analysis was conducted through a multi-step coding process. Initially, open coding identified significant phrases or sentences from the interview transcripts, which were then grouped into broader categories during axial coding. These categories were refined into themes that captured key aspects of how autonomy and self-efficacy influenced students' learning experiences. To ensure consistency and accuracy, inter-coder reliability checks were performed, with discrepancies resolved through discussion. Additionally, member checking was conducted, allowing participants to confirm the accuracy of the findings. The final analysis integrated both qualitative and quantitative results, offering a comprehensive understanding of how autonomy and self-efficacy shaped students' motivation, engagement, and performance in the virtual learning environment.

Results

The results of the study are presented and discussed separately for the quantitative and qualitative phases. The quantitative results address Research Questions 1 and 2, focusing on the relationships between autonomy, self-efficacy, and learning experiences in a virtual setting. The qualitative results, aligned with Research Question 3, explore students' perceptions of the roles of autonomy and self-efficacy in shaping their virtual learning experiences.

Results of the Quantitative Phase

Before presenting the main results of this phase, an overview of the research variables is provided through descriptive statistics in Table 1.

Table 1. Descriptive statistics for research variables

Variable	Mean	Standard Deviation	Variance	Minimum	Maximum
Autonomy	3.1917	0.51129	0.261	1.75	3.69
Self-efficacy	2.8262	0.32896	0.108	2.32	3.54
Learning experiences	3.1423	0.32685	0.107	2.63	3.79

The descriptive statistics in Table 1 provide an overview of the research variables, i.e., autonomy, self-efficacy, and learning experience. The mean for autonomy is at 3.1917, suggesting a relatively strong sense of autonomy; the mean for self-efficacy is 2.8262, indicating a moderate level of self-efficacy among participants; and the mean for learning experiences is 3.1423, reflecting generally positive experiences among the participants. The standard deviations (0.51129 for autonomy, 0.32896 for self-efficacy, and 0.32685 for learning experiences) indicate the extent of variability in the responses, with autonomy showing the highest variability. This is further supported by the variance values, where autonomy has the largest variance (0.261), indicating greater dispersion in responses. The range of scores, from the minimum to the maximum, highlights the diversity of participant responses, particularly for autonomy (ranging from 1.75 to 3.69). These descriptive statistics provide a foundational understanding of the data distribution, essential for subsequent inferential analyses.

Following this, Table 2 presents the results of the One-Sample Kolmogorov-Smirnov Test, which assesses the normality of the variables: listening, speaking, reading, writing, and self-efficacy.

Table 2. One-sample Kolmogorov-Smirnov test

Variable	Listening	Speaking	Reading	Writing	Self-efficacy
N	15	15	15	15	15
Normal Parameters	Mean	Stn. Deviation			
	3.0583	0.35628	2.6476	0.50034	2.3619
			2.8000	0.37331	2.8262
Most Extreme	Absolut				
Differences	0.273	0.114	0.227	0.191	0.147
	positive				
	0.273	0.114	0.227	0.191	0.147
	negative				
Test Statistic	0.273	0.114	0.227	0.191	0.147
Asymp. Sig. (2-tailed)	0.054	0.200	0.066	0.147	0.200

Each variable, with a sample size of 15, shows mean values of 3.0583, 2.6476, 2.3619, 2.8000, and 2.8262, respectively, and corresponding standard deviations. The test statistic values for the most extreme differences are 0.273, 0.114, 0.227, 0.191, and 0.147. Significance levels (Asymp. Sig. 2-tailed) indicate that listening (0.054) and reading (0.066) are close to a normal distribution while speaking (0.200), writing (0.147), and self-efficacy (0.200) closely follow a normal distribution. This normality assessment informs the selection of appropriate statistical methods for subsequent analysis.

Relationship between Autonomy and Learning Experiences in a Virtual Setting

To address the first research question, which explores the relationship between autonomy and learning experiences in a virtual setting, correlation analyses were conducted. Table 3 presents the Pearson correlation coefficients between learning experiences and various dimensions of autonomy, including decision-making, self-care, self-regulation, and problem-solving.

Table 3. Correlations between learning experiences and dimensions of autonomy

	Learning experiences	Decision-making	Self-care	Self-regulation	Problem-solving	Autonomy
Learning experiences	Pearson Correlation	1	0.931**	0.772**	0.780**	0.725**
	Sig. (2-tailed)		0.000	0.001	0.001	0.002
	N	15	15	15	15	15
Decision-making	Pearson Correlation	0.931**	1	0.900**	0.885**	0.803**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000
	N	15	15	15	15	15
Self-care	Pearson Correlation	0.772**	0.900**	1	0.785**	0.908**
	Sig. (2-tailed)	0.001	0.000		0.001	0.000
	N	15	15	15	15	15
Self-regulation	Pearson Correlation	0.780**	0.885**	0.785**	1	0.720**
	Sig. (2-tailed)	0.001	0.000	0.001		0.002
	N	15	15	15	15	15
Problem-solving	Pearson Correlation	0.725**	0.803**	0.908**	0.720**	1
	Sig. (2-tailed)	0.002	0.000	0.000	0.002	0.000
	N	15	15	15	15	15
Autonomy	Pearson Correlation	0.865**	0.965**	0.959**	0.907**	0.911**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
	N	15	15	15	15	15

The correlation analysis reveals significant positive relationships between learning experiences and all dimensions of autonomy. The Pearson correlation coefficients range from 0.725 to 0.931, indicating strong associations. Specifically, learning experiences are most strongly correlated with decision-making ($r = 0.931$, $p < 0.01$), followed by self-regulation ($r = 0.780$, $p < 0.01$), self-care ($r = 0.772$, $p < 0.01$), and problem-solving ($r = 0.725$, $p < 0.01$). The composite measure of

autonomy also shows a strong correlation with learning experiences ($r = 0.865$, $p < 0.01$). These findings suggest that higher levels of autonomy are associated with more positive learning experiences in a virtual setting, emphasizing the importance of fostering autonomous skills to enhance educational outcomes.

To explore the relationship between autonomy and learning experiences in a virtual setting, regression analysis was conducted. Table 4 presents the model summary, which includes essential statistics to evaluate the fit and explanatory power of the regression model.

Table 4. Model summary for regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.956	0.914	0.879	2.66285

Table 4 demonstrates a robust fit of the regression model examining autonomy and its impact on learning experiences. The high R square value of 0.914 indicates that approximately 91.4% of the variance in learning experiences is explained by the model, suggesting a strong relationship between autonomy-related factors and positive learning outcomes in the virtual setting. The adjusted R square of 0.879 adjusts for the number of predictors in the model, confirming the model's reliability. The standard error of the estimate (2.66285) reflects the accuracy of predictions made by the model, with smaller values indicating better predictive accuracy. These findings underscore the significant influence of autonomy on shaping the learning experiences of participants in virtual educational environments, directly addressing Research Question 1.

In further exploring Research Question 1, Table 5 presents the results of the analysis of variance (ANOVA) for the regression model assessing the relationship between autonomy-related factors and learning experiences in a virtual setting.

Table 5. ANOVA results for regression model on autonomy and learning experiences

Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	750.192	4	187.548	26.450
	Residual	70.908	10	7.091	
	Total	821.100	14		

Table 5's ANOVA results confirm the significant impact of autonomy-related factors on learning experiences in the virtual setting. The regression sum of squares (750.192) indicates the amount of variance in learning experiences explained by the regression model, while the residual sum of

squares (70.908) represents unexplained variance. The F-statistic of 26.450 is highly significant ($p < 0.001$), suggesting that the regression model as a whole is effective in predicting learning experiences based on autonomy-related predictors. These findings align with the model's high R square value from Table 4, reinforcing that autonomy plays a crucial role in shaping positive learning outcomes in virtual educational contexts. Therefore, these results directly support and validate findings related to Research Question 1, highlighting the importance of autonomy in enhancing educational experiences in virtual learning environments.

Relationship between Self-Efficacy and Learning Experiences in a Virtual Setting

To address the second research question, which examines the relationship between self-efficacy and learning experiences in a virtual setting, correlation analyses were conducted. Table 6 presents the Pearson correlation coefficients between learning experiences and various dimensions of self-efficacy, including speaking, reading, and writing.

Table 6. Correlations between learning experiences and dimensions of self-efficacy

		Learning experiences	Speaking	Reading	Writing	Self-efficacy
Learning experiences	Pearson Correlation	1	0.713**	0.758**	0.778**	
	Sig. (2-tailed)		0.003	0.001	0.001	
	N	15	15	15	15	
Speaking	Pearson Correlation	0.713**	1	0.619*	0.595*	
	Sig. (2-tailed)	0.003		0.014	0.019	
	N	15	15	15	15	
Reading	Pearson Correlation	0.758**	0.619*	1	0.898**	
	Sig. (2-tailed)	0.001	0.014		0.000	
	N	15	15	15	15	
Writing	Pearson Correlation	0.778**	0.595*	0.898**	1	
	Sig. (2-tailed)	0.001	0.019	0.000	0.000	
	N	15	15	15	15	
Self-efficacy	Pearson Correlation	0.895**	0.801**	0.891**	0.908**	
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	15	15	15	15	

The correlation analysis reveals significant positive relationships between learning experiences and all dimensions of Self-efficacy. The Pearson correlation coefficients range from 0.713 to 0.895, indicating strong associations. Specifically, learning experiences are strongly correlated with self-efficacy ($r = 0.895$, $p < 0.01$), writing ($r = 0.778$, $p < 0.01$), reading ($r = 0.758$, $p < 0.01$), and speaking ($r = 0.713$, $p < 0.01$). These findings suggest that higher levels of self-efficacy are associated with more positive learning experiences in a virtual setting, underscoring the

importance of enhancing self-efficacy to improve educational outcomes in virtual learning environments.

Table 7 presents the model summary, which includes key statistics to evaluate the fit and explanatory power of the regression model.

Table 7. Model summary for regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.903	0.815	0.741	3.90041

Table 7 reveals a strong fit for the regression model examining the relationship between self-efficacy and learning experiences. The R-value of 0.903 indicates a strong correlation between the predictor variables (self-efficacy-related factors) and the outcome variable (learning experiences). The R square value of 0.815 suggests that approximately 81.5% of the variance in learning experiences is explained by the model, demonstrating a high explanatory power. The adjusted R square of 0.741 adjusts for the number of predictors, reinforcing the model's reliability. The standard error of the estimate, 3.90041, indicates the average distance that the observed values fall from the regression line, with a smaller value suggesting a better fit. These results highlight the significant impact of self-efficacy on learning experiences in a virtual setting, directly addressing Research Question 2.

To further explore Research Question 2, Table 8 presents the ANOVA results for the regression model assessing the relationship between self-efficacy and learning experiences in a virtual setting.

Table 8. ANOVA results for regression model on self-efficacy and learning experiences

Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	668.968	4	167.242	10.993
	Residual	152.132	10	15.213	
	Total	821.100	14		

Table 8's ANOVA results underscore the significant impact of self-efficacy-related factors on learning experiences in the virtual setting. The regression sum of squares (668.968) represents the explained variance by the model, while the residual sum of squares (152.132) indicates the unexplained variance. The F-statistic of 10.993, with a significance level (p-value) of 0.000, demonstrates that the regression model is statistically significant. This indicates that self-efficacy-related predictors significantly contribute to explaining the variance in learning experiences. These

findings align with the model summary in Table 7, reinforcing that self-efficacy is a crucial factor in enhancing learning outcomes in virtual environments. Therefore, these results directly support and validate findings related to Research Question 2, highlighting the importance of self-efficacy in shaping educational experiences in virtual settings.

Table 9 presents the correlation among autonomy, self-efficacy, and learning experiences in a virtual setting based on participant responses. This table provides a detailed overview of how autonomy and self-efficacy relate to participants' perceived learning experiences in the virtual educational context. Each participant's scores are categorized to highlight the combinations of autonomy, self-efficacy, and learning experiences observed within the study.

Table 9. Correlation among self-efficacy, autonomy, and learning experiences in a virtual setting

Participants	Autonomy	Self-efficacy	Learning experiences	Respondent's status
1	3.25	2.32	2.79	High autonomy, moderate self-efficacy, and moderate learning experiences in virtual settings.
2	3.69	3.54	3.61	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
3	3.50	2.96	3.23	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
4	3.56	2.71	3.14	High autonomy, almost high self-efficacy, and high learning experiences in a virtual setting.
5	3.00	2.57	3.7	High autonomy, almost high self-efficacy, and high learning experiences in a virtual setting.
6	3.13	2.93	3.03	High autonomy, almost high self-efficacy, and almost high learning experiences in virtual settings.
7	3.56	2.89	3.23	High autonomy, almost high self-efficacy, and high learning experiences in a virtual setting.
8	2.81	2.61	2.71	Average autonomy, average self-efficacy, and average learning experiences in the virtual setting.
9	3.56	3.25	3.41	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
10	3.31	3.07	3.19	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
11	3.69	3.14	3.42	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
12	3.44	2.50	2.97	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
13	1.75	2.54	3.14	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
14	2.94	2.79	2.86	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.
15	2.69	2.57	2.63	High autonomy, high self-efficacy, and high learning experiences in a virtual setting.

The scores reflect varying levels of autonomy, self-efficacy, and perceived learning experiences. Participants with higher scores in autonomy tend to report higher self-efficacy and more positive

learning experiences. Notably, several participants consistently reported high scores across all three variables, indicating a strong positive correlation between autonomy, self-efficacy, and enhanced learning outcomes in virtual educational environments. These findings suggest that fostering autonomy and enhancing self-efficacy are crucial factors in promoting effective learning experiences in virtual settings.

Results of the Qualitative Phase

Students' Perceptions of the Influence of Autonomy and Self-efficacy on Learning Experiences in a Virtual Setting

To address the third research question, semi-structured interviews explored students' perceptions of how autonomy and self-efficacy influenced their virtual learning experiences. The analysis identified three key themes highlighting the impact of autonomy and self-efficacy on students' academic engagement and performance as well as the interplay between autonomy and self-efficacy.

Table 10 categorizes autonomy into three categories: Control over the Learning Process, Flexibility in the Learning Environment, and Ownership of Learning Outcomes, highlighting how participants leveraged autonomy to personalize and enhance their virtual learning experiences. The code frequencies indicate varying emphasis on each aspect, reflecting the diverse ways autonomy influenced their educational engagement.

Table 10. Dimensions of autonomy and their impact on virtual learning experiences

Category	Code	Frequency
Control over the Learning Process	Ability to choose learning materials	12
	Independent scheduling of study time	10
	Freedom to decide on assignment formats	8
	Customizing learning tasks	6
Flexibility in the Learning Environment	Access to resources at any time	11
	Personalized pace of learning	9
	Adapting learning approaches to goals	8
	Availability of digital tools and content	7
Ownership of Learning Outcomes	Accountability for academic results	13
	Responsibility for completing tasks on time	11
	Self-reflection on learning progress	10
	Tracking progress independently	9
	Setting achievable personal goals	8

The codes and categories in Table 10 illustrate how autonomy empowered participants to take control of their learning, adapt to virtual settings, and take responsibility for their outcomes. Within Control over the Learning Process, 12 participants emphasized the ability to choose learning materials and 10 highlighted independent scheduling, which aligned with one participant's reflection: *"Having the freedom to choose how I study and which resources to use has made learning more enjoyable and effective for me."* Similarly, Flexibility in the Learning Environment was critical, with 11 participants valuing accessible resources and 9 benefiting from personalized pacing, demonstrating how adaptable tools supported diverse learning styles. The strongest impact was observed in Ownership of Learning Outcomes, where 13 participants expressed accountability and 10 engaged in self-reflection. This sense of ownership fostered intrinsic motivation, as one participant explained: *"Being able to plan my study schedule and set my own goals has made me more engaged in my learning process."* These findings argue that providing autonomy in virtual education not only enhances engagement but also encourages learners to take initiative and responsibility, ultimately leading to better academic outcomes. The evidence supports integrating autonomy-focused strategies in virtual learning to foster active, motivated, and self-directed learners. Table 11 highlights the key dimensions of self-efficacy and its impact on virtual learning. It categorizes self-efficacy into four areas: Belief in Overcoming Challenges, Confidence in Academic Abilities, Persistence and Resilience, and Self-Perception of Success, showcasing how students' confidence influenced their engagement, problem-solving, and motivation in a virtual setting.

Table 11. Dimensions of self-efficacy and their impact on virtual learning experiences

Category	Code	Frequency
Belief in Overcoming Challenges	Confidence in the ability to tackle difficult assignments	13
	Optimism towards solving complex problems	11
	Ability to adapt to unexpected challenges	9
	Maintaining focus under pressure	8
Confidence in Academic Abilities	Trust in skills to complete academic tasks	14
	Belief in achieving set academic goals	12
	Confidence in understanding course materials	10
Persistence and Resilience	Continuing effort despite repeated difficulties	12
	Trying alternative approaches to solving problems	10
	Recovering from academic setbacks	9
	Sustained motivation in challenging tasks	8
	Using failures as learning opportunities	6
Self-Perception of Success	Viewing oneself as capable of academic success	13
	Recognizing improvements through effort	11
	Positive self-talk to maintain motivation	9

The findings in Table 11 underscore the pivotal role of self-efficacy in shaping students' virtual learning experiences. Belief in Overcoming Challenges was significant, with 13 participants expressing confidence in tackling difficult assignments and 11 emphasizing optimism toward solving complex problems. Additionally, 9 participants noted adaptability to unexpected challenges, and 8 highlighted their ability to maintain focus under pressure, reflecting resilience in navigating virtual learning demands. As one participant shared, *"Believing in my abilities allowed me to take charge of my learning journey and become more independent in managing my studies."* Similarly, Confidence in Academic Abilities emerged as a key dimension, with 14 participants trusting their skills to complete tasks, 12 believing in achieving academic goals, and 10 expressing confidence in understanding course materials. These findings highlight how self-efficacy fosters a sense of competence and independence, enabling learners to effectively manage their academic responsibilities.

Persistence and Resilience further illustrated the impact of self-efficacy, with 12 participants maintaining effort despite challenges, 10 trying alternative approaches, and 9 recovering from academic setbacks. Moreover, 8 participants sustained motivation during difficult tasks, and 6 viewed failures as opportunities for growth, underscoring the adaptive mindset fostered by self-efficacy. One participant noted, *"I make sure to ask questions and seek feedback regularly to ensure I'm on track and understanding the material thoroughly."* Finally, Self-Perception of Success played a critical motivational role, with 13 participants viewing themselves as capable of academic success, 11 recognizing improvements through effort, and 9 employing positive self-talk to maintain motivation. Together, these findings emphasize how self-efficacy promotes resilience, engagement, and adaptability in virtual learning. To enhance these outcomes, educators should prioritize strategies such as offering constructive feedback, encouraging self-reflection, and providing opportunities for mastery, thereby fostering confidence and persistence in learners.

Table 12 presents the key aspects of the interplay between autonomy and self-efficacy in virtual learning, categorized into six dimensions: Self-Directed Learning, Confidence in Learning Tasks, Time and Goal Management, Feedback Utilization, Motivation and Persistence, and Peer Collaboration and Interaction, with corresponding frequencies highlighting their significance.

Table 12. Key aspects of the interplay between autonomy and self-efficacy in virtual learning

Category	Code	Frequency
Self-Directed Learning	Initiative in directing one's learning	12
	Taking responsibility for learning outcomes	11
	Seeking additional learning resources	9
	Balancing autonomy and reliance on guidance	8
	Setting clear personal goals	7
Confidence in Learning Tasks	Belief in the ability to handle complex tasks	13
	Confidence in completing assignments independently	12
	Trust in personal problem-solving skills	10
	Ability to persevere through challenges	9
	Developing strategies to overcome obstacles	7
Time and Goal Management	Planning study schedules effectively	14
	Adjusting goals to reflect progress	10
	Allocating time for independent and collaborative tasks	8
	Monitoring personal progress	7
Feedback Utilization	Seeking feedback from instructors	12
	Applying feedback to improve academic performance	11
	Reflecting on feedback to adjust strategies	9
Motivation and Persistence	Staying motivated despite challenges	13
	Using autonomy to sustain engagement	12
	Leveraging self-efficacy to build confidence	10
	Maintaining persistence during setbacks	8
	Staying focused on long-term academic goals	7
Peer Collaboration and Interaction	Engaging peers for collaborative learning	11
	Sharing strategies and learning experiences	10
	Seeking clarification and support from peers	8
	Building confidence through peer feedback	7

The interplay between autonomy and self-efficacy, as reflected in Table 12, underscores their indispensable roles in shaping effective virtual learning experiences. Self-directed learning emerged as a key dimension, with high frequencies for "Initiative in directing one's learning" (12) and "Taking responsibility for learning outcomes" (11), emphasizing how autonomy allows students to personalize their education while self-efficacy builds their confidence to succeed. One participant reflected, *"Believing in my abilities allowed me to take charge of my learning journey and become more independent in managing my studies."* However, the lower frequency of "Balancing autonomy and reliance on guidance" (8) indicates that while autonomy is empowering, structured support is still necessary to ensure students do not feel overwhelmed. In confidence in learning tasks, 13 participants reported a "Belief in ability to handle complex tasks," and 10 highlighted "Trust in personal problem-solving skills," further illustrating how self-efficacy drives persistence. One participant explained, *"When I believe I can solve a problem, I don't hesitate to try multiple strategies,"* pointing to the value of self-efficacy in encouraging adaptive problem-solving. However, the lower emphasis on "Developing strategies to overcome obstacles" (7)

suggests a gap in teaching students how to complement their confidence with practical tools for problem-solving.

Other dimensions further underscore the interdependence of autonomy and self-efficacy. In time and goal management, "Planning study schedules effectively" (14) and "Adjusting goals to reflect progress" (10) demonstrated how autonomy supports organization, while self-efficacy provides the confidence to execute plans successfully. Yet, the relatively lower frequency of "Monitoring personal progress" (7) reveals a need for more consistent reflective practices. Feedback utilization similarly revealed this dynamic, with 12 participants "Seeking feedback from instructors" and 11 "Applying feedback to improve performance." One participant noted, *"I make sure to ask questions and seek feedback regularly to ensure I'm on track and understanding the material thoroughly,"* showing how autonomy drives proactive engagement, while self-efficacy empowers learners to act on the feedback received. However, "Reflecting on feedback to adjust strategies" (9) highlighted room for growth in integrating feedback for sustained improvement. Lastly, motivation and persistence as well as peer collaboration demonstrated how these attributes sustain resilience and engagement. Codes such as "Staying motivated despite challenges" (13) and "Engaging peers for collaborative learning" (11) underscore the importance of autonomy and self-efficacy in promoting active learning. A participant shared, *"I feel more confident when I work with others who value my input and provide constructive feedback,"* highlighting how self-efficacy fosters meaningful collaboration. These findings argue for targeted strategies to strengthen both autonomy and self-efficacy, ensuring learners remain resilient, adaptive, and engaged in virtual settings.

Discussion

The findings of this study strongly reinforce the notion that autonomy plays a critical role in shaping positive learning outcomes in virtual settings. Students who had more control over their learning process, such as choosing their materials, setting schedules, and taking responsibility for their outcomes, reported better learning experiences. This resonates with the work of Han and Geng (2023), who also highlighted the importance of learner autonomy in online contexts, finding that students who were empowered to make decisions about their learning were more likely to engage deeply with the content and produce better outcomes. Additionally, Ludwig and Tassinari (2023) similarly emphasized that autonomy boosts engagement by allowing students to adapt their learning pace and approach.

However, while our findings support the view that autonomy enhances learning outcomes, they also suggest that autonomy cannot function in isolation, an aspect that is often underexplored in the literature. The data from this study indicate that a significant number of students reported difficulty balancing autonomy with structured support, which contrasts with the findings of Alemayehu and Chen (2023), who argued that autonomy, particularly in virtual environments, can be overwhelming without sufficient guidance from instructors. Specifically, this study found that lower frequencies of "Balancing autonomy and reliance on guidance" and "Monitoring personal progress" indicate a need for more explicit scaffolding, especially for students who may struggle with self-regulation. This highlights a gap in Ludwig and Tassinari's (2023) model, which tended to emphasize autonomy without giving equal weight to the role of guidance.

This discrepancy implies that the current study suggests a more nuanced approach, where a balance between autonomy and structured support is necessary for optimal learning outcomes. For instance, Biwer et al. (2021) noted the same tension when examining students' shift to online learning during the pandemic, where learners with more prior experience in self-regulation thrived, while those without it faced difficulties. This finding suggests that the current model of learner autonomy in virtual education may need to be revisited to incorporate targeted interventions that ensure students do not become overwhelmed by their independence. Thus, a hybrid approach, which combines learner autonomy with strategic support, may be more effective than a purely autonomous framework.

The second major finding of this study relates to the significant role self-efficacy plays in enhancing learning experiences within virtual settings. The data shows that students with higher self-efficacy tended to have better academic outcomes. This finding aligns with Heo et al. (2021), who found that self-efficacy positively influences students' motivation, particularly in online environments where students are more isolated. Similarly, Alemayehu and Chen (2023) also reported that self-efficacy significantly impacts students' persistence and success in virtual learning contexts, with high self-efficacy fostering greater academic resilience.

Nevertheless, the study introduces a critical perspective on how self-efficacy alone is insufficient in fostering engagement without the appropriate structures in place. For example, the finding that students maintained persistence despite challenges because of their self-efficacy echoes Pendergast et al. (2022), who suggested that self-efficacy can mediate the relationship between

challenges and success. However, the study also identified areas where self-efficacy did not translate into effective problem-solving or consistent self-reflection, particularly in the lower frequency of "Developing strategies to overcome obstacles." This gap in self-regulation, which is not heavily discussed in Zheng and Xiao (2024), suggests that self-efficacy while boosting confidence and persistence, may not be sufficient to equip students with the practical tools they need to navigate complex learning tasks. This discrepancy highlights the importance of Zheng and Xiao's (2024) recommendation that fostering self-regulated learning strategies—alongside self-efficacy—could enhance the overall effectiveness of virtual learning environments.

Moreover, the critical role of feedback in fostering self-efficacy in this study, where students not only sought but applied feedback to improve their performance, is in line with Zheng and Xiao (2024), who emphasized the significance of feedback in virtual settings. However, this study further elaborates on the gaps in reflective practices, with lower frequencies of "Reflecting on feedback to adjust strategies," indicating that students may need more guidance on how to use feedback effectively. This provides a critical extension to the work of Pendergast et al. (2022), who briefly mentioned the positive influence of feedback on self-efficacy but did not delve into how students might be better supported in integrating this feedback into their learning processes.

Perhaps the most intriguing aspect of this study is the examination of the interaction between autonomy and self-efficacy, which was found to be instrumental in shaping students' virtual learning experiences. The study shows that autonomy supports self-direction in learning, while self-efficacy fosters the confidence needed to succeed within that framework. This interplay is consistent with Wang and Shan (2018), who proposed that autonomy and self-efficacy are mutually reinforcing, with self-efficacy providing the motivation needed to take advantage of autonomous learning opportunities.

However, this study offers a deeper exploration of how students navigate the balance between these two constructs. The finding that students who felt confident in their abilities were also better able to manage their learning schedules, set goals, and take responsibility for their outcomes suggests that the relationship between autonomy and self-efficacy is complex. While Wang and Shan (2018) emphasized the synergistic relationship between these two factors, the current study highlights that some students struggle with managing autonomy without sufficient guidance. The lower frequency of "Balancing autonomy and reliance on guidance" suggests that students may

feel overwhelmed when tasked with fully autonomous learning tasks, which contradicts the more idealized notion of fully self-directed learners. This contrasts with DeNoyelles et al. (2014), who advocated for a more fully autonomous, self-regulated learning environment, underscoring that a lack of structure can lead to disengagement.

These findings suggest a reconsideration of the *ideal* learning environment in virtual education. Rather than advocating for complete autonomy or full reliance on instructor-led guidance, the evidence here supports the importance of a hybrid model, where both autonomy and self-efficacy are cultivated, but students are also provided with consistent support and feedback. This hybrid approach would balance the benefits of autonomy with the critical scaffolding needed to support learners in navigating complex virtual environments.

Conclusion

This study highlights the significant roles of autonomy and self-efficacy in shaping students' virtual learning experiences. Autonomy, through control over the learning process and resources, fosters engagement and self-direction, while self-efficacy boosts confidence in overcoming challenges, contributing to resilience and persistence. The findings demonstrate that students with higher autonomy tend to report stronger self-efficacy, reinforcing the interconnectedness of these factors in enhancing learning outcomes. The synergy between autonomy and self-efficacy is crucial for creating an environment that supports independent and resilient learners.

The implications of this study suggest that virtual learning environments should strike a balance between autonomy and structured support. Educators should create opportunities for students to manage their learning while offering guidance when necessary. Emphasizing self-regulation and providing feedback for reflection are key strategies to enhance both autonomy and self-efficacy. Overall, the study advocates for intentional design in virtual learning spaces that fosters independence and confidence, leading to improved student engagement and performance.

However, this study has several limitations. The sample was limited to a specific group of students, which may reduce the generalizability of the findings. Additionally, self-reported data introduces potential biases, as students' perceptions may not always align with actual behaviors. The study also did not account for contextual factors like course content or instructor presence, which may also influence learning experiences in virtual environments.

Future research should explore the long-term impact of autonomy and self-efficacy on virtual learning outcomes through longitudinal studies. Investigating individual differences such as learning styles and prior experiences could provide a more nuanced understanding of how these factors affect learning. Intervention studies aimed at improving self-regulation and feedback integration would also offer valuable insights into how educators can better foster autonomy and self-efficacy in virtual settings.

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Data Availability Statement

The original contributions presented in the study are included in the article/supplementary material, and further inquiries can be directed to the corresponding author.

Author Contributions

All authors contributed to the study's conception and design, material preparation, data collection, and analysis, as well as to the article and approved the submitted version.

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Conflict of Interest

The authors declare that the research was conducted without any commercial or financial relationships that could potentially create a conflict of interest.

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