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Toward Students' Adoption of Digital Collaboration: The Role of Self-Regulated Learning and Technology Readiness and Acceptance

Completed Research Full Paper

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Abstract

The adoption of digital collaboration in higher education depends on students' ability to engage with Technology-Enhanced Learning Environments (TELE). Self-regulated learning (SRL) plays a crucial role in facilitating this adoption, yet its relationship with technology readiness and acceptance remains underexplored. This study investigates how SRL strategies, measured using the Learning Strategies in Studies – short Version (LIST-k) relate to students' technology readiness and acceptance in collaborative TELE (cTELE) using the Technology Readiness and Acceptance Model (TRAM). Based on a quantitative analysis of students in an IS course, we examine correlations between LIST-k and TRAM constructs, revealing that metacognitive regulation and concentration significantly influence perceived usefulness and attitude toward cTELE. Findings suggest that SRL skills can enhance students' adoption of TELE. The study contributes to educational technology research by integrating LIST-k into TRAM and providing valuable insights for the design of cTELE.

Keywords

Technology-Enhanced Learning Environment, collaboration, self-regulated learning, technology readiness

Introduction

In today's digital higher education (HE), collaboration depends on the availability of tools and the ability of students to engage with these tools (M. H. Lin et al., 2017; Mena-Guacas et al., 2024). Collaboration scripts (CS) have emerged as a valuable pedagogical method in Technology-Enhanced Learning Environments (TELE), particularly in Computer-Supported Collaborative Learning. CS enable collaboration among students and promote critical thinking. (Healey, 2018; Kollar et al., 2006) However, the transition from traditional face-to-face instruction to digital formats requires students to develop control in managing their learning processes, as a lack of these skills can lead to procrastination, course dropout, or even expulsion. The increased flexibility of digital education has made self-regulated learning (SRL) more important than ever. (Faathima Fayaza & Ahangama, 2024) The concept of SRL emphasizes learners' ability to plan, monitor and evaluate their own learning (Zimmerman, 2002) and those who consistently apply SRL strategies demonstrate strong self-regulation (Weinstein et al., 2011). Furthermore, CS can guide learning interactions and provide scaffolding for SRL (Heinonen et al., 2020; Kollar et al., 2006; Schnaubert & Vogel, 2022). However, the success of collaborative TELE (cTELE) is shaped by students' acceptance of these tools (Rosli & Saleh, 2022) and their ability to self-regulate their learning (Dettori & Persico, 2008). More precisely, successful TELE adoption depends on students' technology readiness (TR), a concept part of the Technology Readiness and Acceptance Model (TRAM) by M. H. Lin et al. (2017). This model combines technology acceptance factors with users' psychological and behavioral characteristics. Existing models have yet to fully explore these relationships, creating a gap in

understanding how to support CS (C.-H. Lin et al., 2007; Panadero, 2017) To bridge this gap, our research explores the relationship between SRL strategies and TELE acceptance, investigating how SRL supports students' adoption of these technologies (Bernacki et al., 2011; Faathima Fayaza & Ahangama, 2024). There is a lack of understanding regarding the impact of students' SRL skills on their TR and TELE adoption. Despite the growing application of TRAM and SRL in educational research, their integration remains underexplored (Panadero, 2017; Rosli & Saleh, 2022). Addressing this gap is crucial for fostering goal-oriented and effective digital learning experiences. Our research follows the Design Science Research (DSR) methodology of Hevner (2007). We strive to offer practical insights for educators. Therefore, we aim to answer the following research question (RQ): *How do SRL strategies relate to students' readiness and acceptance of technology in collaborative TELE?* To answer the RQ, we analyze the relationship between SRL, measured via LIST-k and TRAM in a quantitative study with students from an IS course. Our findings serve as a foundation for future research, with implications for understanding TELE acceptance and the role of SRL strategies. By combining these insights, we aim to inform educators, TELE designers, and developers and offer practical implications for improving TELE adoption. Our study contributes to research by offering insights into the interplay between SRL and TR in TELE.

Theoretical Background and Related Work

CS are structured frameworks used in TELE, especially in Computer-Supported Collaborative Learning, to guide student interactions and enhance collaborative learning. These scripts consist of pre-defined components: learning goals, activity types, task sequences, role assignments, and instructions, that are designed to support meaningful engagement among learners. (Kollar et al., 2006) In TELE contexts, these scripts support the management of flow of activities and ensure that students focus on both the content and the collaborative process (Schnaubert & Vogel, 2022). For instance, Özbek et al. (2024) found that the integration of clear learning objectives into CS improved students' engagement and knowledge acquisition in TELE. This means that CS can encourage students to adopt effective SRL strategies while collaborating, fostering a structured and productive learning experience. However, their effectiveness in TELE depends on students' ability to regulate their learning processes. This highlights the crucial role of SRL strategies, which enable learners to plan, monitor, and adapt their engagement within cTELE. (Wang et al., 2017)

Self-regulated learning

SRL Strategy	Underlying SRL Strategy
Cognitive	<i>Organizing</i> : structuring and arranging learning content systematically
	<i>Elaboration</i> : connecting new learning content to existing knowledge
	<i>Critical Thinking</i> : Critically analyze learning content
	<i>Repeating</i> : structured repetition of learning material
Meta-cognitive	<i>Goal setting and planning</i> : set goals and plan to accomplish them
	<i>Regulation</i> : adapting learning strategies if current approaches are not working adequately
	<i>Monitoring</i> : evaluating whether the learned material has been truly understood
Resource Management	<i>Concentration</i> : maintaining concentration on learning tasks and avoiding distractions
	<i>Effort</i> : having awareness and willingness to put in effort
	<i>Time management</i> : recording the learning time
	<i>Learning with fellow students</i> : forming study groups for collaborative learning
	<i>Literature</i> : using literature to extend learning content and resolve uncertainties
	<i>Learning environment</i> : ensuring an appropriate learning environment

Table 1: Strategies of self-regulated learning (Klingsieck, 2018; Wild & Schiefele, 1994)

SRL refers to the ability of learners to understand and control their learning behavior actively (Zimmerman, 1990, 2002). Furthermore, it addresses the ability to plan, motivate and adjust learning processes (Boekaerts, 1999). The use of SRL strategies can lead to lower stress levels (La Fuente et al., 2020) and better learning outcomes (Schneider & Preckel, 2017). Research highlights specific learning strategies employed by self-regulated learners (Pintrich & Groot, 1990), which can be divided into three superordinate learning strategies (Table 1): 1) *Cognitive* learning strategies address information intake, processing, and storage in memory. 2) *Metacognitive* learning strategies involve planning of learning, controlling of learning progress, and adaptive regulation. 3) *Resource Management* includes how learners manage

available resources. (Klingsieck, 2018; Wild & Schiefele, 1994) To assess the extent to which SRL occurs, the level of SRL is measured through validated questionnaires, such as the Learning and Study Strategies Inventory (Weinstein et al., 1987) and the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1993). Based on the items of the MSLQ (Pintrich et al., 1993), the Learning Strategies in Studies (LIST) and LIST-k were developed for German university students. The LIST consists of 77 items and addresses the four categories (Wild & Schiefele, 1994), while the LIST-k offers a shorter version consisting of 39 items and also addresses the categories of the SRL strategies (Klingsieck, 2018). Since our research was conducted at a German university and did not want to overwhelm the students with too many questions in one questionnaire. To avoid survey fatigue, we used LIST-k. Moreover, to leverage the potential of TELE and SRL, it is crucial to know students' level of SRL and how these aspects relate to their engagement in TELE. At the example of digitally provided CS, that in order to gain insight into this interplay it is essential to investigate how students apply SRL strategies in cTELE (Wang et al., 2017).

Technology Readiness and Technology Acceptance

TRAM combines the TR Index (TRI) (Parasuraman, 2000) with the Technology Acceptance Model (TAM) (Davis, 1989) to explain how individuals adopt and engage with technology. While TAM focuses on perceived usefulness (PU) and perceived ease of use (PE) as adoption drivers, TR accounts for users' psychological predispositions toward technology. In contrast to broader models such as UTAUT, which emphasize external influences, e.g., social influence or facilitating conditions, TRAM is particularly suited for TELE, as it integrates both cognitive and behavioral factors into the adoption of digital learning. (C.-H. Lin et al., 2007) The TAM is one of the most widely used models within IS research as it considers users' system acceptance. More precisely, user acceptance can be determined by the user's attitude toward its use (ATT) and intention to use the system (BI), both of which are influenced by PU and PE. PU refers to the degree to which an individual believes that using the system will enhance its performance, while PE relates to the belief that using the system will require minimal effort. PE has a direct relationship. In addition, the robustness of TAM has been confirmed in numerous empirical studies that have examined or extended the model to explain various technology adoption behaviors. (Davis, 1989; C.-H. Lin et al., 2007) TR focuses on general beliefs toward technology and the utilization of new technologies (Parasuraman, 2000). The TRI was developed as a standardized instrument to measure users' readiness to adopt technology and addresses four dimensions: optimism (OPT), innovativeness (INN), discomfort (DIS), and insecurity (INS). OPT represents a positive, optimistic attitude along with increased control, flexibility and efficiency beliefs. INN refers to the idea of having an innovative attitude. DIS refers to the perception of having insufficient control over technology and the feeling of being overwhelmed by its complexity. INS addresses the user's negative and skeptical attitude toward the technology. (Kampa, 2023; C.-H. Lin et al., 2007) OPT and INN can be seen as enablers, while DIS and INS can be seen as inhibitors. (C.-H. Lin et al., 2007; Parasuraman, 2000)

Although TAM and TRAM can explain technology adoption in education, TRAM does not fully capture SRL, which plays a key role in students' ability to engage with TELE. Integrating SRL into TRAM can enhance its explanatory power by accounting for cognitive and behavioral factors in technology adoption (C.-H. Lin et al., 2007; Zimmerman, 1990). TRAM acknowledges that students enter TELE with varying degrees of TR, which affects their ability to self-regulate their learning in digital environments (M. H. Lin et al., 2017). Unlike other models such as UTAUT, which emphasize organizational and social factors, TRAM is appropriate for TELE as it explains how psychological and behavioral predispositions influence students technology adoption (C.-H. Lin et al., 2007). Examining the relationship between SRL and TRAM is essential for understanding student engagement in cTELE. SRL reflects how students actively manage their learning, while TRAM captures their perceptions about technology. In cTELE, where both SRL and engagement are crucial for successful learning outcomes, combining SRL and TRAM provides a comprehensive perspective on how students interact with digital tools. It offers insights into the learning processes and the motivational factors that drive effective engagement with technology.

Related Work

To understand the interplay between SRL and TR, it is essential to draw on insights from two key areas: a) studies employing the TRAM, and b) research using SRL questionnaires to measure SRL strategies. By

referring to these areas, we aim to bridge the existing research gap in understanding the relationship between SRL and TR. Recent literature has increasingly focused on the application of TRAM across various domains. For instance, Kampa (2023) has investigated TRAM in the context of mobile learning, providing insights how TR and acceptance influence learners' interaction with mobile platforms. Similarly, Buyle et al. (2018) have applied TRAM in the context of smart cities, demonstrating its utility in understanding technology adoption behavior in innovative urban ecosystems. However, these valuable insights overlook the relevant role of students' learning strategies such as SRL, which are crucial for goal-oriented engagement with learning technologies. Thus, bridging the gap between TRAM and SRL, it is essential to examine how learners' readiness to adopt technology intersects with their ability to regulate their learning processes. To contribute to this understanding, our research draws on studies that have measured SRL using validated questionnaires such as LIST-k. Steinherr and Vay (2023) combined the LIST-k with self-leadership strategies and conducted multiple linear regressions to explore the impact of students use of SRL strategies. Their findings underscore the role of SRL in shaping individual learning behaviors, and reinforce the importance of self-regulation in academic contexts. Pan et al. (2024) highlight the relationship between digital competence and personal INN, and its effect on students learning behaviors. Their findings underscore the importance of learning characteristics in terms of technology acceptance. However, exploring how SRL levels relate to TRAM is to the best of our knowledge scarcely investigated. We strive to gain a deeper understanding of how students' SRL strategies link to TELE acceptance.

Correlation analysis

Methodology and Results

We collected data within one basic IS lecture with students at a German university. The data set contains 30 samples of students from IS (56.7%) and IE (43.3%) study programs between their first and fifth semester. Data collection with LIST-k and demographic data took place during the first course session. TRAM data were collected in the third week, after students had engaged with the cTELE artifact which was embedded in the lecture content. This timing allowed for sufficient exposure to the TELE environment while aligning with the course schedule. To ensure comparability between both data collection points, students were asked to create and provide a pseudonym that allows for anonymous comparisons. We measured students' SRL using the LIST-k on a 5-point Likert scale and the TRAM on a 7-point Likert scale (1 = *strongly disagree*, 5/7 = *strongly agree*). To ensure comparability and reduce distortion, TRAM responses were transformed to a 5-point scale. This normalization was essential to maintain statistical consistency, avoid variance mismatches, and allow for valid correlations between both instruments without compromising the validity of the data. (Dawes, 2008)

Gender	Male		Female	
	20 (66.7%)		10 (33.3%)	
Study program	IS		Industrial Engineering (IE)	
	17 (56.7%)		13 (43.3%)	
Semester	1		3	
	17		12	
	5		1	

Table 2: demographic data of the sample

Internal consistency and descriptive data

We first analyzed Cronbach's alpha (α) to ensure the internal consistency of both questionnaires (Table 3 and 4). Furthermore, the descriptive data show that students use learning strategies at varying levels. While SD2 has the highest mean value, SD1 shows the lowest mean value. The reliability analysis shows that not all LIST-k constructs meet the minimum internal consistency of $\alpha > .65$ (Taber, 2018). Consequently, we exclude the constructs O2, O1, MS2, MS1. Moreover, MS2 exhibits a negative α and high covariance, likely due to cultural/contextual factors such as different item interpretations or survey design issues such as ambiguous item wording. For the TRAM, the descriptive data show that the students' overall assessment of the constructs is neutral. No value is below 3.16 (*neutral*), only OPT has a value over 4.00 (*agree*). The reliability analysis reveals that not all constructs meet the threshold of $\alpha > .65$ which is a well-accepted

α -value in empirical studies especially when dealing with complex cognitive and behavioral constructs (Taber, 2018). To ensure a balanced interpretation of SRL and technology acceptance, we exclude DIS, INS, and OPT from further analysis.

		SRL strategy	α	Min	Max	Mean
Cognitive	O1	Organizing	0.60	2.33	4.67	3.40
	O2	Elaboration	0.53	2.33	5.00	3.76
	O3	Critical Thinking	0.75	1.00	4.33	3.27
	O4	Repeating	0.70	2.00	4.67	3.23
Metacognitive	MS1	Goal setting and planning	0.48	2.00	5.00	3.53
	MS2	Monitoring	-0.06	2.67	4.67	3.73
	MS3	Regulation	0.72	2.33	4.67	3.64
Resource management	SD1	Concentration	0.80	1.67	4.00	2.72
	SD2	Effort	0.66	2.33	5.00	3.88
	SD3	Time management	0.67	1.33	4.67	2.56
	S1	Learning with fellow students	0.78	2.67	5.00	3.70
	S2	Literature	0.58	1.67	4.00	3.10
	S3	Learning environment	0.76	1.00	5.00	3.19

Table 3: Descriptive data of the LIST-K constructs

TRAM	α	Min	Max	Mean
DIS	0.30	1.83	3.83	3.16
INN	0.88	1.83	4.50	3.56
INS	0.54	2.47	4.60	3.49
OPT	0.42	3.17	4.67	4.22
ATT	0.85	3.00	4.50	3.58
BI	0.93	2.33	4.83	3.49
PE	0.90	2.47	4.33	3.51
PU	0.96	2.07	4.87	3.60

Table 4: Descriptive data of the TRAM constructs

Relationship of self-regulated learning strategies and technology readiness

		MS3	O3	O4	S1	S3	SD1	SD2	SD3	INN	ATT	BI	PE	PU
MS3	r	1	0.328	-0.249	0.181	-0.189	0.047	-0.122	0.292	-0.187	0.321	0.301	0.267	0.401*
	p		0.077	0.184	0.338	0.318	0.806	0.520	0.118	0.323	0.083	0.106	0.154	0.028
O3	r	0.328	1	-0.254	0.236	-0.194	-0.014	-0.415*	0.180	-0.076	-0.127	0.047	-0.008	-0.041
	p	0.077		0.175	0.210	0.304	0.942	0.023	0.341	0.690	0.504	0.806	0.966	0.831
O4	r	-0.249	-0.254	1	-0.314	0.222	0.017	0.076	-0.100	-0.032	-0.211	-0.121	-0.339	-0.291
	p	0.184	0.175		0.091	0.238	0.929	0.688	0.600	0.868	0.264	0.524	0.067	0.119
S1	r	0.181	0.236	-0.314	1	-0.215	0.028	-0.104	-0.084	-0.008	0.246	0.261	0.007	0.121
	p	0.338	0.210	0.091		0.253	0.881	0.584	0.658	0.966	0.189	0.164	0.971	0.525
S3	r	-0.189	-0.194	0.222	-0.215	1	0.350	0.096	0.105	0.102	0.187	0.308	0.315	0.080
	p	0.318	0.304	0.238	0.253		0.058	0.613	0.580	0.592	0.323	0.098	0.090	0.675
SD1	r	0.047	-0.014	0.017	0.028	0.350	1	0.194	0.253	-0.003	0.423*	0.279	0.195	0.381*
	p	0.806	0.942	0.929	0.881	0.058		0.304	0.177	0.987	0.020	0.135	0.301	0.038
SD2	r	-0.122	-0.415*	0.076	-0.104	0.096	0.194	1	0.172	-0.150	-0.032	-0.107	-0.053	0.083
	p	0.520	0.023	0.688	0.584	0.613	0.304		0.363	0.428	0.866	0.574	0.783	0.663
SD3	r	0.292	0.180	-0.100	-0.084	0.105	0.253	0.172	1	0.052	-0.053	0.081	0.186	0.022
	p	0.118	0.341	0.600	0.658	0.580	0.177	0.363		0.783	0.782	0.669	0.325	0.907
INN	r	-0.187	-0.076	-0.032	-0.008	0.102	-0.003	-0.150	0.052	1	0.033	0.118	0.306	0.048
	p	0.323	0.690	0.868	0.966	0.592	0.987	0.428	0.783		0.862	0.535	0.099	0.801
ATT	r	0.321	-0.127	-0.211	0.246	0.187	0.423*	-0.032	-0.053	0.033	1	0.689**	0.704**	0.847**
	p	0.083	0.504	0.264	0.189	0.323	0.020	0.866	0.782	0.862		0.000	0.000	0.000
BI	r	0.301	0.047	-0.121	0.261	0.308	0.279	-0.107	0.081	0.118	0.689**	1	0.662**	0.660**
	p	0.106	0.806	0.524	0.164	0.098	0.135	0.574	0.669	0.535	0.000		0.000	0.000
PE	r	0.267	-0.008	-0.339	0.007	0.315	0.195	-0.053	0.186	0.306	0.704**	0.662**	1	0.753**
	p	0.154	0.966	0.067	0.971	0.090	0.301	0.783	0.325	0.099	0.000	0.000		0.000
PU	r	0.401*	-0.041	-0.291	0.121	0.080	0.381*	0.083	0.022	0.048	0.847**	0.660**	0.753**	1
	p	0.028	0.831	0.119	0.525	0.675	0.038	0.663	0.907	0.801	0.000	0.000	0.000	
r Pearson correlation				* p < .05			** p < .01							

Table 5: Pearson correlation analysis

To identify correlations between SRL and TR, we performed a Pearson's correlation analysis (Table 5). This is a widely used statistical method for measuring the linear relationship between two continuous variables.

By applying Pearson's correlation analysis, we aim to provide insights into the interplay between SRL strategies and TR, thus contributing to a deeper understanding of student engagement in TELE. Significant correlations were found between MS3 and PU, SD1 and ATT, as well as SD1 and PU. Within LIST-k we could identify a negative correlation between O3 and SD2 while TRAM revealed positive correlations between ATT and BI, ATT and PE, ATT and PU, BI and PU, BI and PE, as well as between PE and PU.

Discussion

In order to address the presented RQ, this study sought to explore the relationship between SRL strategies and TRAM in the context of cTELE, contributing to the theoretical understanding of how students interact with TELE. The findings should be interpreted considering the sample size. Nonetheless, the detected patterns provide valuable insights into the interplay between SRL and TRAM, helping to address students' acceptance of digital technologies. It is important to emphasize that these correlations do not necessarily indicate causality. We consider correlations up to a significance level of $p < .05$ to be statistically significant (Cohen, 2013). For trends approaching significance of $p < .1$, we acknowledge potential implications for future research: The positive correlation between MS3 and PU ($r=.401$, $p=.028$) aligns with previous research by Klingsieck (2018), who emphasized that students who regulate their learning processes tend to view educational technologies as more beneficial. By using metacognitive skills students are able to use them in a goal-oriented and efficient manner to achieve their learning goals. As students regulate their learning, the usefulness of technology can increase. Moreover, students with metacognitive skills may be better identify and use the affordances of technology to achieve their learning goals. Students with higher concentration skills (SD1) perceive TELE as both useful (PU) and engaging (ATT): A moderate positive correlation was found between SD1 and PU ($r=.381$, $p=.038$). It is possible that students with higher levels of concentration skills perceive digital tools to be more useful. Concentration may act as an amplifier of PU by improving the understanding, efficiency, and positive evaluation of the technology. Students focus and navigate through the learning materials. This offers tangible benefits such as increased productivity and efficient learning processes, while reinforcing their belief that the technology is useful (Theobald, 2021). SD1 and ATT have a significant positive correlation ($r=.425$, $p=.020$). Students who maintain their concentration within the collaborative task and cTELE tend to develop a higher ATT. It is possible that the collaborative nature of the tasks may have influenced this relationship, as students may focus more intently to ensure group progress (Theobald, 2021). This finding underscores the importance of TELE design that supports concentration, such as streamlined interfaces and minimal distractions. A learning environment that minimizes distractions may contribute to higher levels of ATT. The findings above align with existing research that emphasizes the role of cognitive and metacognitive skills in technology acceptance (Davis, 1989; Klingsieck, 2018). The results indicate that students' SRL strategies, particularly metacognitive regulation and concentration, are significantly correlated with the constructs of TELE acceptance, particularly through their relationships with ATT and PU. This study extends TRAM by highlighting the role of SRL as a factor in TELE acceptance. Unlike traditional models, e.g., TAM and UTAUT, which focus on system characteristics and external factors. Our study emphasizes the role of students' cognitive and behavioral engagement in shaping TELE acceptance. Several significant, mostly positive correlations were identified within each questionnaire. The LIST-k constructs SD2 and O3 ($r=-.415$, $p=.023$) show a moderate negative correlation suggesting that while critical thinking is essential for higher order thinking, it may also be cognitively demanding, potentially reducing the effort students are willing or able to invest in their studies (Klingsieck, 2018). This finding is consistent with existing research on the cognitive load associated with higher order thinking skills and highlights the need for strategies that balance analytical engagement with sustained effort. Strong correlations were found between ATT, BI, PU, and PE, consistent with prior studies (Davis, 1989; Kampa, 2023; C.-H. Lin et al., 2007). ATT and BI have a strong correlation ($r=.689$, $p=.000$), highlighting that a positive attitude toward technology promotes its integration into learning routines. Similarly, ATT and PE have a strong correlation ($r=.704$, $p=.000$), emphasizing the importance of PE. Digital CS further support a positive attitude toward technology (Kollar et al., 2006). Additionally, ATT and PU show a strong positive correlation ($r=.847$, $p=.000$): The more useful students perceive the technology, the more positive their attitudes become. This fosters active engagement with collaborative tasks and increases learning motivation (Davis, 1989). BI and PU are also positively correlated ($r=.660$, $p=.000$), as students are more likely to use the technology when it facilitates efficient collaboration in TELE.

BI and PE exhibit a positive correlation ($r=.662$, $p=.000$), as an intuitive user experience and clear instructions facilitate adoption (Kollar et al., 2006). Finally, the high correlation between PE and PU ($r=.753$, $p=.000$) underscores the importance of ease of use, as it reduces cognitive load and allows students to focus on learning. These findings are particularly relevant for cTELE, where both self-regulation and technology acceptance are essential for successful participation. Students are expected not only to engage with digital tools but also to collaborate. SRL strategies such as monitoring and concentration are especially important, as they enable students to manage their individual responsibilities within group tasks. At the same time, TRAM constructs such as PU and PE shape students' willingness to actively engage in the collaborative settings. The positive correlations between SRL and TRAM suggest that students who effectively regulate their learning are more likely to perceive cTELE as useful and engaging. This suggests that SRL may act as a catalyst for TELE acceptance, especially in cTELE, where maintaining focus and sustaining motivation are essential to fostering productive collaborative learning. While not all correlations reached statistical significance at the $p < .05$ level, some relationships at level of $p < .1$ may still indicate meaningful trends, particularly due to the small sample size. Therefore, correlations at $p < .1$ are discussed as potential paths for future research. The exploratory approach facilitates the identification of patterns that merit further investigation, while acknowledging the need for larger studies to substantiate these findings. (Cohen, 2013) O4 and S1 show a negative correlation ($r=-.314$, $p=.091$), highlighting the SRL interplay between repetition and learning with peers. As students become more engaged at repetition their participation in peer-based learning activities (S1) tends to decrease. Although CS settings incorporate repetition tasks, these tasks require at least two students, limiting opportunities for independent reinforcement of knowledge and potentially discouraging students who prefer solitary repetition. (Kollar et al., 2006; Özbek et al., 2024) The LIST-k constructs S3 and SD1 are positively correlated ($r=.350$, $p=.058$). The streamlined design of the technology helps students focus on the content without distractions. Features such as a streamlined user interface, progress bar, absence of unnecessary pop-ups, small tasks with time limits, and clearly defined learning goals support concentration in TELE. (Klingsieck, 2018; Kollar et al., 2006) A well-designed learning environment enables the intention to use technology. The positive correlation between the two constructs shows this relationship between S3 and BI ($r=.308$, $p=.098$). A structured and user-centered learning environment facilitates access to learning resources and reduces barriers to use. As a result, students have a positive experience and are more likely to continue using the system. Factors such as knowledge of the learning environment, e.g., the university's learning management system, familiar tools, a structured interface and prompts contribute to a positive user experience. The positive correlation between INN and PE ($r=.306$, $p=.099$) indicates that students with higher INN perceive the technology as more usable. These students are more likely to explore new functionalities, overcome obstacles independently, and view new features as opportunities rather than burdens. Their ability to adapt facilitates overall technology adoption and supports SRL within TELE. Lastly, S3 and PE have a negative correlation ($r=.315$, $p=.099$). The absence of a repetition function negatively impacts students PE. This hinders meaningful repetition and reduces PE. Consequently, PE may decrease, as it does not fully support independent repetition.

Practical Implications

The results of the study suggest valuable practical implications for the development and improvement of cTELE. The correlation analysis provides guidance for educators, instructional designers, and developers: The positive correlation between ATT and student concentration underscores the importance of minimizing distractions and minimizing the interface, while avoiding excessive use of visual elements. Features such as task progress tracking, small tasks with time limits, and clear learning goals, supporting students in remaining aware of their learning progress, clearly defined learning goals that provide structure and direction, selected pop-ups, and notifications may help foster student focus and engagement. Furthermore, the relationships between SRL strategies and PU suggest that supporting metacognitive skills may increase the perceived value of TELE. To support students, monitor and regulate their learning, it can be helpful to incorporate adaptive features into the TELE such as learning analytics, e.g., as dashboards, timers or progress bars. It has been observed that the absence of tasks for individual repetition has a negative impact on the PE of artifacts. Future approaches should incorporate functionalities that enable students to repeat tasks independently, without relying on peer collaboration. Lastly, the results demonstrate the importance

of comprehensive guidance and prompts within the artifact to enhance PE and student autonomy. Educators, educational technology designers, and developers can use these implications to support meaningful student engagement in TELE, fostering both engagement and autonomy. Future approaches should include clear step-by-step guides to help students understand features and functionalities, along with just-in-time support without overwhelming them. Additionally, ensuring that lecturers are available for questions is crucial. Providing clear guidance by CS can be an useful approach to support students through structured interactions (Kollar et al., 2006). This approach fosters SRL and proactively supports students using TELE. The findings emphasize the crucial role of SRL strategies in student acceptance of TELE. To effectively support self-regulation, TELE should incorporate features that facilitate progress tracking, reflection, and task repetition as these can enhance technology acceptance by fostering student autonomy and engagement. Key design considerations for TELE should include a streamlined interface to minimize distractions, adaptive learning analytics to help students regulate their SRL strategies, the ability to independently repeat tasks, and clear instructional guidance that enhances PE. By implementing these features, TELE may not only improve student engagement and learning outcomes but also increase overall technology acceptance.

Theoretical Contribution

This study contributes to the theoretical understanding of SRL and TRAM by exploring their interplay in cTELE. Specifically, it extends TRAM by integrating SRL constructs of the LIST-k, thus addressing a research gap in educational technology. The study demonstrates that students' SRL strategies are significantly related to their perceptions of technology acceptance. This enhances the explanatory power of TRAM in educational settings, while offering a more holistic view of technology acceptance that considers (meta)cognitive processes, such as regulation, concentration, and effort, as an integral part of technology adoption. While examining the relationship between SRL strategies and TRAM constructs, the study provides insights into the role of self-regulation in shaping students' perceptions of PU and PE. Our study adds a novel perspective by exploring the relationship between existing SRL levels and students' perceptions and acceptance of TELE. Rather than viewing TELE solely as a tool for developing SRL, this research explores how students' levels of SRL shape their engagement and attitudes toward TELE. The findings indicate that SRL is not only relevant for students' learning outcomes but is also a relevant aspect of TELE acceptance. Our findings can be seen as a foundation for further iterations of the artifact and offer a basis for future research integrating SRL and TRAM in educational settings. Beyond its contribution to SRL and TRAM, the study advances DSR in educational technology by providing guidance for TELE development. Future DSR efforts can build on these findings to develop more adaptive, student-centered learning technologies that facilitate both self-regulation and seamless technology adoption. Unlike existing technology adoption models, e.g., TAM, UTAUT, which focus primarily on system characteristics and external factors, this study highlights the importance of students' learning behaviors. It emphasizes that technology adoption is shaped not only by system characteristics but also by self-regulatory skills. This offers new directions for IS education research and reinforces the importance of learning strategies in TELE.

Outlook on Future Research and Limitations

By answering our RQ, we provide valuable insights into the relationship between SRL strategies and TRAM within cTELE. However, some limitations must be acknowledged: Not all constructs met the internal consistency criterion, resulting in the exclusion of eight constructs. While this step improves statistical validity, it results in a fragmented representation of the theoretical models. The excluded constructs may reveal meaningful relationships in a different sample. Furthermore, the limited sample size may constrain generalizability, reliability, and statistical power. The included constructs demonstrate solid internal consistency, supporting the robustness of the findings. Still, the small sample size may increase the risk of wider confidence intervals, reduced statistical power, and potential sampling bias. Nonetheless, it provides valuable initial insights for basic research based on the identified significant correlations. To enhance reliability, statistical power, and generalizability, we strive to carry out a subsequent study with a larger, more diverse sample (e.g., across different study programs or cohorts). Advanced analytic techniques such

as Structural Equation Modeling or Multiple Linear Regressions will also allow for a more nuanced understanding of the relationships between SRL and TRAM constructs. In addition, we acknowledge that the correlation analysis does not establish causal relationships. Further exploration of excluded constructs could provide a deeper understanding of their role in collaborative TELE adoption. In terms of DSR, we strive to improve the artifact based on our findings and students' feedback, incorporating features for independent task repetition and interactive features, such as quizzes, feedback mechanisms, and dashboards. Future research can further develop both theoretical understanding and practical applications to support the adoption of cTELE. We also encourage researchers to extend this research by examining whether the findings apply to other contexts, such as corporate training environments or professional development programs, and how the results might differ across generations of learners. Understanding how SRL and TR influence learning outcomes beyond HE can provide valuable insights. Finally, in the age of AI it SRL skills are essential to remain competitive in learning and work environments (Nguyen et al., 2024).

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I take the responsibility for using AI, specifically for improving language, readability, and understanding. However, the formulation of the clauses was my own.

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