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Graduate students' self-regulated learning practices in dual-monitor academic environments

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Abstract. This study investigates how graduate students utilise dual-monitor setups to facilitate self-regulated learning (SRL) during academic tasks. Using a thematic qualitative study with a phenomenological orientation, semi-structured interviews and photo-elicitation techniques were conducted with eleven graduate students who actively employ dual monitors for their studies. Thematic analysis revealed that participants viewed dual-monitor configurations as tools for organisation, workflow smoothness, and focus. Dual monitors enabled parallel access to resources, facilitated smoother task coordination, and promoted planning and task strategies associated with the forethought and performance phases of SRL. Students also linked their setups to emotional regulation and professional identity, describing greater confidence and perceived reductions in stress when using two monitors. The findings suggest that dual monitors serve as effective supports for learning regulation. Future studies should examine disciplinary variations and employ experimental or mixed-method approaches to assess the impact of dual-monitor use on measurable self-regulatory processes and learning outcomes.

Keywords: self-regulated learning, dual-monitor setup, academic workspace, technology-enhanced learning

1. Introduction

The integration of technology into academic work has reshaped how students plan, organise, and complete their tasks. Among the tools that have become increasingly common in higher education are dual-monitor setups, which provide students with expanded digital workspaces to manage multiple resources at once. In professional contexts, dual monitors are standard for tasks that require organisation, multitasking, and efficiency; however, their role in academic settings remains underexplored, particularly regarding how students themselves experience and adapt these setups for learning. In research-intensive academic work, students increasingly operate within complex digital environments that integrate writing platforms, data analysis tools, visualisation software, and online resources, making the spatial distribution of information across monitors a potentially meaningful factor in regulating learning activities.

A key lens for examining how students use dual monitors is self-regulated learning (SRL). SRL is a crucial aspect of learning, as evidenced by extensive research in educational psychology that demonstrates its significant role in enhancing academic outcomes [42]. SRL refers to the processes by which students actively and intentionally manage their own learning, studying, or academic engagement [69, 74]. Rather than treating SRL as a fixed set of skills, contemporary perspectives emphasise its dynamic and context-sensitive nature, highlighting how both personal and environmental conditions shape learners' regulatory practices. Numerous models describe the SRL process; however, Zimmerman's model is among the most comprehensive, providing detailed insights into the operation of each phase [48]. The process is cyclical and comprises three separate phases: forethought (e.g., planning), performance (e.g., strategy implementation), and self-reflection (e.g., evaluation and

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modification) [47, 72]. While the theoretical foundations of this model are discussed in greater depth in the literature review, it is introduced here to situate the present study's focus on planning and task execution within a recognised SRL framework. Students' ability to navigate these phases effectively is closely linked to their academic achievement and persistence. Research consistently indicates that effective SRL strategies correlate with improved academic performance by helping students organise their efforts, maintain motivation, and adapt to challenging contexts [4, 12, 52, 53, 55]. In higher education, this is especially vital as students have considerable autonomy regarding the methods, timing, and location of their studies [26]. As society progresses technologically, students are required to develop robust SRL skills to thrive as lifelong learners [17].

According to Junaštíková [29], technology offers a variety of tools that students can utilise to improve their knowledge and regulate their learning processes. Researchers have examined students' strategies for reading, writing, and problem solving in subjects such as mathematics and science [49]. Panadero [47] recommends developing additional SRL models and assessments that can adapt to evolving technological environments. Furthermore, Gambo and Shakir [21] emphasise the need to investigate SRL methods that remain unexamined, particularly in innovative educational settings, especially smart learning environments. Likewise, Kanwal et al. [30] suggests using qualitative approaches, such as interviews, to gain in-depth insights into students' interactions with technology in authentic academic contexts. Despite this growing body of work, relatively little qualitative research has focused on students' lived experiences with dual-monitor setups as self-regulatory resources embedded in everyday academic practice.

Zimmerman's cyclical model [72, 74] emphasises the three phases through which learners plan, apply strategies, and evaluate outcomes. Within this framework, dual monitors may serve as affordances for both the forethought phase (e.g., planning and organising resources) and the performance phase (e.g., dividing subtasks across monitors as part of task-strategy implementation) as perceived and described by students in their academic work. Such affordances may also influence how students allocate visual attention, manage competing information streams, and sustain focus during complex academic tasks. Despite evidence that SRL is strongly linked to academic success [26, 47], limited research has examined how specific technologies, particularly dual-monitor setups, shape students' learning regulation.

Existing studies on dual monitors have primarily focused on productivity, multitasking, and cognitive load [11, 60], often relying on quantitative performance indicators such as task completion time, error rates, or interaction efficiency. These studies suggest potential benefits for academic work, but little is known about how students themselves experience and apply SRL strategies in dual-monitor setups. In particular, gaps remain regarding how dual monitors support planning and task strategies, two central aspects of effective SRL that directly influence students' ability to manage complex academic demands, especially from a qualitative, experience-based perspective that foregrounds learners' perceptions, intentions, and strategies rather than measured output.

1.1. Statement of the problem

While previous research highlights the general benefits of SRL and the productivity advantages of dual-monitor setups, little is known about how students use these setups to support their academic work through SRL processes. Most studies on dual monitors emphasise quantitatively measured efficiency, multitasking, or cognitive load, but they do not address how these tools influence learners' planning, organization, or task strategies as students experience, interpret, and enact them in authentic academic contexts. As a result, existing research offers limited insight into how students themselves make sense of dual-monitor use in their everyday learning practices. This gap is especially critical as higher education increasingly requires students to independently manage complex tasks and integrate digital technologies into their learning. Addressing this gap can deepen our understanding of how dual-monitor setups support SRL by foregrounding students' lived experiences of workflow smoothness and task coordination, and provide insights into designing more effective and responsive digital learning environments.

1.2. Research questions

This article addresses that gap by examining graduate students' lived experiences with dual-monitor setups. Guided by Zimmerman's SRL model, the study focuses on two research questions:

1. How do graduate students perceive the role of dual-monitor setups in planning their academic work?
2. How do graduate students apply task strategies when completing academic work with dual-monitor setups?

The article contributes to both SRL theory and its practical applications by emphasising students' perspectives on technology-supported regulation. It demonstrates how students experience dual monitors as technological tools for organising resources, sequencing tasks, and supporting the enactment of learning strategies during academic work. The findings also offer practice-oriented insights for digital learning environments and institutional support for students' workspace needs.

2. Literature review

2.1. Self-regulated learning

Self-regulated learning (SRL) theory emphasises the development of metacognition, motivation, and strategic action, highlighting learners who are self-aware, persistent, and capable of adapting strategies to meet diverse learning demands [8]. It explains how students take control of their learning processes and proactively initiate or supplement experiences designed to educate themselves [74]. Over time, several frameworks have been developed to describe the processes of self-regulated learning from multiple perspectives [66]. These frameworks highlight different dimensions of SRL and underscore its importance in guiding students' learning activities, particularly in modern educational contexts, while also allowing room for qualitative inquiry into how learners experience and enact these processes in practice.

Zimmerman's model remains one of the most comprehensive and widely applied. It identifies three interrelated phases (forethought, performance, and self-reflection) that together form a cyclical process of self-regulation [74]. As mentioned earlier, this study focuses specifically on the forethought and performance phases, as they encompass the core elements of planning and task strategy use. By focusing on these two phases, the study directly examines how students prepare for academic work and employ strategies when completing academic tasks in dual-monitor setups. In the forethought phase, learners set goals, evaluate their motivation and abilities, and plan for engaging with the task [73]. This stage lays the foundation for proactive engagement and strongly influences the quality of subsequent efforts [14, 27]. Effective planning requires students to examine their task environment and identify specific requirements, such as resources or guidance needed to succeed [36]. Additionally, strategic planning enables learners to break down activities into manageable steps and assess their ability to complete them [71]. Examples include allocating time blocks for research, drafting, and revision, or setting goals for task delegation in group projects [44]. Such planning enhances clarity and direction [67] and provides a framework for translating objectives into actionable steps, such as scheduling study sessions, organising materials, or outlining priorities [3].

The performance phase involves sustaining attention, applying strategies, and monitoring progress while completing tasks. This stage, often referred to as volitional control, includes processes such as self-instruction, imagery, and attention focusing [61]. Learners must employ self-control strategies, such as time management, environmental structuring, and imagery, to remain cognitively engaged [37]. Task strategies play a central role, as they help students break down problems into smaller components and reorganise them meaningfully [35]. Performance also requires ongoing monitoring of cognitive and emotional strategies to ensure alignment with task demands [8], a process that can be meaningfully examined through learners' reflective accounts of their academic practices.

Students also pay close attention to their study environments, often opting for structured settings that encourage focus and minimise distractions. Environmental structuring involves deliberately shaping or adjusting the learning space to support performance and limit interruptions [40]. Adenipekun, Ajibola and Oluwunmi [1] identify the ownership and control of space, as well as its capacity to facilitate individual or collaborative work, as critical factors influencing the effectiveness of academic tasks. Further, Yang et al. [70] characterise this as learners employing strategies to mitigate distractions by modifying their environment to make it more suitable for studying. For instance, learners may avoid disturbances, select comfortable study locations, and regulate their use of digital devices and internet access to remain aligned with their academic goals [25, 41]. Such practices underscore the importance of managing the learning environment to sustain attention and improve workflow, particularly when viewed from the learner's experiential perspective.

Research consistently highlights the importance of specific strategies within the performance phase. Broadbent [9] identifies time management and elaboration as key predictors of academic success in both online and blended learning environments. Kanwal et al. [30] emphasise that time management is essential for academic achievement and crucial for building self-regulated study habits in university students. Broadbent et al. [10] report that students who confidently managed their study schedules performed significantly better than those with weaker SRL skills, while Johanna [28] shows that time management and motivation account for 42% of the variance in SRL behaviours among working college students. These findings confirm the pivotal role of time management across contexts. At the same time, variation exists in that students employ different SRL strategies depending on their environment. For example, online learners tend to use SRL strategies more frequently than those in blended environments, though differences emerge in peer learning and help-seeking behaviors [5, 9, 18].

Focusing attention is essential, enabling students to minimise distractions and maintain concentration [61]. For instance, organising study spaces and avoiding distractions, such as television, can enhance concentration and promote the practical application of learning strategies. Importantly, researchers emphasise that Zimmerman's phases are not rigidly sequential or strictly linear; instead, they illustrate how learners adaptively regulate thoughts, emotions, and behaviours interactively across different stages of academic work [69]. Together, these insights frame SRL as a dynamic, cyclical process through which learners intentionally, adaptively, and persistently manage and strategise academic tasks, offering a strong theoretical foundation for qualitative investigations of technology-mediated learning experiences such as dual-monitor use.

2.2. Technology and SRL

Modern technology plays a significant role in shaping students' ability to self-regulate their learning. Its impact largely depends on how it is integrated into the learning environment to foster self-regulation [29]. The use of technology has evolved from desktop and laptop computers to mobile devices, tablets, and cloud-based platforms, leading to more flexible, mobile learning habits [64]. This shift has allowed students to study on the go, but it has also introduced new complexities in how they regulate learning across devices and platforms.

Educational technologies have been shown to foster SRL, enhance academic performance, and increase student motivation [46]. By offering diverse learning options, digital tools encourage the development of self-regulation skills [6, 54]. When students engage with technology in ways that support SRL, their academic outcomes improve significantly [29]. In fact, developing strong SRL skills is essential for thriving as lifelong learners in a technology-driven society [17, 43]. Digital tools support this process by enabling learners to strategically align their actions with academic goals, monitor progress, and refine strategies over time [62]. Thereby highlighting the importance of intentional and reflective technology use rather than passive adoption.

Despite these benefits, challenges remain. Yot-Domínguez and Marcelo [71] found that university students, who are regular users of digital tools for personal and social activities, are less inclined to use them for self-regulating their academic learning. Conversely, An et al. [2] reported a positive relationship between technology-based SRL strategies and improved English learning outcomes, demonstrating that effective integration of digital tools can strengthen SRL. An et al. [2] further argue that understanding the interplay between SRL strategies, motivation, and outcomes is crucial for educators.

Learners also employ technology in diverse ways, using the same resources differently depending on their needs and goals. For example, Hu and Yu [22] and Lai, Hu and Lyu [32] note that learners strategically decide how to use technological tools, whether for selecting resources, managing information, or setting objectives, to optimise outcomes. Students who are more accepting of technology are often better equipped to regulate their learning, underscoring the importance of cultivating positive attitudes toward technology use in education [62].

From a cognitive perspective, students can regulate their metacognitive abilities by utilising technology to plan, gather information, expand their knowledge, and monitor their progress toward goals [29]. Learners also rely on cognitive, metacognitive, and resource management strategies, such as organising materials and structuring study environments, to manage their learning effectively in digital contexts [63, 68]. Taken together, this body of research demonstrates that technology has become a critical mediator of self-regulated learning. It not only offers tools that support planning, strategy use, and monitoring, but also presents challenges that require intentional and adaptive use. Importantly, this line of research highlights how the value of technology for SRL is shaped by how learners perceive, appropriate, and integrate digital tools into their academic practices, rather than by the tools' objective features alone. In this broader context, dual-monitor setups can be seen as one of many technological affordances that students employ to regulate their academic work.

2.3. Dual-monitor setup

The integration of dual-monitor setups has become an increasingly visible feature of academic and professional work environments. Dual-monitor configurations enable learners to display and compare multiple sources of information simultaneously, facilitating the visualisation of interconnected concepts and promoting a deeper understanding of complex topics [11]. Studies show that additional monitor support for task management allows users to run applications, view images, and organise resources side by side, reducing the time spent switching between windows and streamlining workflows [24, 60].

Multi-display environments also benefit instructors, who often require greater workspace to deliver multimedia content across multiple windows [13, 56]. As users adapt to additional displays, their workflows become increasingly structured and coordinated [23]. This additional screen real estate has been shown to improve comprehension when information is categorised and displayed across multiple monitors [33, 51], and is especially advantageous for complex tasks such as coding, data analysis, and multimedia projects [20]. Prior research in this area has predominantly operationalised benefits in terms of measured performance indicators, including reductions in task time, improved cursor movement, and fewer window switches [39, 59].

Beyond measured efficiency outcomes, dual monitors influence attentional processes. Shin, An and Kim [58] demonstrated that attentional shifts between screens affect recognition memory: sequential screen use improved accuracy, while simultaneous use risked divided attention and cognitive overload. Lee, Baek and Han [34] demonstrated that the effectiveness of dual monitoring depends on cognitive load. For medium-load tasks, splitting content across displays enhanced learning, whereas high-load tasks led to overload and impaired performance. In the same context, the screen arrangement and content distribution should align with user goals to optimise performance and comfort, as multi-screen environments can substantially increase cognitive load and visual attention demands, depending on how information is spatially organized [65]. These findings highlight that dual monitors are not inherently beneficial, but their value depends on how learners manage attention and organise information across monitors.

Preferences for dual monitors are also reported. Users cite practical benefits such as improved task management, reduced window switching, and more organised workflows [39]. Lin and Chen

[38] observed slight, though not statistically significant, performance improvements when dual-monitor setups were tailored to user preferences, highlighting the role of personalisation in optimising outcomes within quantitative performance-focused paradigms.

Despite these benefits, access to dual-monitor setups in educational settings remains limited. University computer labs and classrooms frequently restrict students to a single monitor, diverging from real-world practices and potentially hindering effective problem-solving in areas such as programming [60]. Collectively, these studies establish the productivity, organisational, and attentional benefits of dual-monitor environments. However, they primarily focus on efficiency metrics, multitasking, or cognitive load, rather than on students' lived experiences or on how dual monitors support self-regulated learning processes such as planning and task-strategy use. This limitation points to the need for a qualitative inquiry that examines how learners perceive, appropriate, and strategically use dual monitors in authentic academic contexts. This gap positions the current study to extend prior work by examining dual monitors as tools within the broader framework of SRL from a qualitative, phenomenological perspective that foregrounds learners' perceptions, intentions, and enacted strategies.

3. Methodology

3.1. Research design

This study adopts a qualitative research design to explore graduate students' lived experiences with dual-monitor setups in academic work. The study is framed as a qualitative thematic study with a phenomenological orientation, focusing on how participants describe, interpret, and make meaning of their experiences using dual monitors in academic contexts. This approach prioritises participants' perspectives while allowing for systematic thematic analysis across accounts. A phenomenological orientation was selected because it is particularly well-suited to capturing the essence of participants' experiences. Creswell and Creswell [15] describe phenomenology as a design of inquiry grounded in philosophy and psychology that seeks to describe individuals' lived experiences of a phenomenon as articulated by participants themselves. Also, Patton [50] emphasises how phenomenology explores how individuals make sense of their experiences and how these experiences shape their perceptions and actions. Moreover, this study draws on phenomenological principles to inform data collection and interpretation, particularly by emphasising participants' first-person accounts, reflective descriptions, and contextualised meaning-making. The analytic process followed a thematic approach, allowing patterns and shared meanings to be identified across participants while remaining grounded in their lived experiences.

Given the limited research on dual-monitor use in higher education, this approach is well aligned with Creswell and Creswell's [15] assertion that phenomena requiring exploration and deeper understanding, particularly in understudied contexts, merit a qualitative design. By adopting a thematic qualitative design informed by phenomenological perspectives, the study foregrounds the subjective meanings and interpretations that students assign to their use of dual monitors, considering both the technological context and the academic demands that shape their self-regulated learning strategies. This approach also enables the examination of how students' reflections and self-perceptions impact their planning and task strategies when using dual-monitor technologies.

3.2. Participants and sampling

Participants were recruited using a combined sampling strategy that integrated criterion sampling and maximum variation sampling. Criterion sampling ensured that only students with relevant experience were included. Moser and Korstjens [45] explain that criterion sampling is common in phenomenological research for selecting participants with direct engagement with the phenomenon under investigation. In this study, the criterion was the active use of dual-monitor setups for academic purposes, ensuring participants could provide meaningful insights into self-regulated learning practices based on their firsthand academic experiences.

Participants were recruited from a single public research-intensive university in the United States. All participants were enrolled as graduate students (Master's, PhD, or professional doctoral programs) and were engaged in coursework, research, or both at the time of data collection. The study focused on on-campus and hybrid students whose academic work involved sustained interaction with digital tools and screen-based tasks.

Recruitment was conducted through targeted e-mail invitations distributed via graduate program mailing lists and departmental contacts, supplemented by follow-up referrals from initial participants (i.e., a limited snowball sampling approach). Recruitment materials outlined the purpose of the study, participation requirements, and time commitment. Students who expressed interest were screened to confirm eligibility prior to inclusion.

To broaden perspectives, maximum variation sampling was also employed. Douglas [19] notes that maximum variation sampling seeks participants with diverse experiences to capture a wide range of experiences. In this study, variation was intentionally sought across multiple dimensions, including academic discipline, degree level, type of academic work, and patterns of dual-monitor use. Participants represented disciplines across STEM, health sciences, social sciences, and humanities-related fields, and included both early-stage and advanced graduate students. Variation was further reflected in how participants configured and used their dual-monitor setups, such as fixed desktop monitors versus laptop–monitor combinations, and differences in the frequency and intensity of multi-screen use during academic tasks.

Maximum variation was assessed iteratively during recruitment and data collection. As the interviews progressed, the researcher monitored emerging similarities and differences in participants' descriptions of dual-monitor use, particularly regarding planning practices, task coordination, and screen allocation strategies. Recruitment continued until additional interviews no longer yielded substantively new perspectives on these experiential dimensions. Accordingly, students from different disciplines, year levels, and learning contexts were recruited to identify common patterns and variations in how dual-monitor setups affect planning and task strategies in self-regulated learning.

The final sample consisted of eleven participants, which aligns with common recommendations for phenomenological and experience-oriented qualitative studies that prioritise depth of description over breadth. Creswell and Poth [16] suggests that 10–12 participants are typically sufficient for qualitative studies aimed at exploring attitudes and perceptions, particularly when the goal is to develop rich, in-depth understandings of participants' experiences rather than statistical generalisation. Data saturation was determined pragmatically, based on the recurrence of thematic patterns and the diminishing emergence of novel experiential insights related to the research questions. By the eleventh interview, participants' accounts consistently reiterated previously identified meanings and strategies, indicating that sufficient depth and variation had been achieved for this study.

3.3. Data collection

Semi-structured interviews served as the primary data collection method. This technique was chosen because it strikes a balance between structure and flexibility, allowing for consistent coverage of central topics while leaving space for participants to elaborate on their unique perspectives. Semi-structured interviews are well-suited to phenomenological inquiry because they allow researchers to explore the meaning, structure, and essence of participants' lived experiences in depth. Interview questions were designed to elicit detailed descriptions of participants' planning behaviours, task execution strategies, emotional responses, and workspace organisation when using dual-monitor setups, rather than to test predefined hypotheses or measure performance outcomes. This design aligned with the study's focus on understanding how participants interpret and make sense of their academic practices.

To further enrich the interviews, the Photo Elicitation Technique was integrated. Shaw [57] and Kyololo, Stevens and Songok [31] describe this method as using photographs during interviews to stimulate reflection and articulation. In this study, participants were invited to provide photographs of their dual-monitor setups and study environments. These images served as prompts during the interviews, enabling participants to describe their learning contexts in greater detail and with more clarity. The photographs were not analysed as visual data; rather, they served as reflective artefacts that supported participants' verbal meaning-making and recall of their experiences. This combination of semi-structured interviews and photo elicitation provided a robust, comprehensive approach to data generation grounded in participants' perspectives.

All participants provided informed consent prior to participation. The study received institutional ethical approval, and procedures were implemented to ensure confidentiality and anonymity, including the removal of identifying information from transcripts and photographs. Digital data (audio recordings, transcripts, and images) were stored securely on password-protected university servers accessible only to the researcher.

3.4. Procedures and data analysis

Each interview lasted approximately 30–60 minutes and was audio-recorded with participant consent. Photos submitted by participants were incorporated into the interview discussions to guide reflection, with the emphasis placed on participants' verbal interpretations of their experiences. In keeping with phenomenological principles, the researcher adopted a reflexive stance throughout data collection and analysis, maintaining analytic memos to document assumptions, emerging interpretations, and decisions made during coding. This process supported ongoing reflexivity regarding the researcher's role in interpreting participants' accounts. Following data collection, thematic analysis was employed, as outlined by Braun and Clarke [7], to interpret the data. This involved an inductive coding process in which transcripts were read multiple times to identify meaningful units of text related to participants' experiences with dual-monitor use.

Coding proceeded through several stages: initial familiarisation with the data; generation of preliminary codes capturing experiential meaning units; iterative comparison and refinement of codes; and construction of higher-order themes representing shared patterns across participants' accounts. Themes were then examined in relation to Zimmerman's SRL framework, with particular attention to the forethought and performance phases. Rather than treating the SRL model as a rigid coding template, it was used as an interpretive lens to contextualise participants' descriptions of planning, task execution, environmental structuring, and affective regulation. This analytic approach enabled the study to capture both the commonalities and unique variations in participants' experiences of dual-monitor use for planning and task strategies.

In line with phenomenological principles, the analysis focused not only on categorising behaviours but also on interpreting the lived meaning of dual-monitor use as described by participants. Meaning units were examined for how students experienced regulation, organisation, and emotional control in context, rather than being treated as isolated functional actions. Themes were constructed to reflect shared experiential structures across accounts, capturing how participants understood and enacted dual-monitor use within their academic lives. This interpretive orientation ensured that findings remained grounded in participants' meaning-making processes rather than in predefined performance constructs.

3.5. Researcher reflexivity

The researcher maintained a reflexive stance throughout the study, recognising prior familiarity with dual-monitor environments in academic and professional contexts. To minimise interpretive bias, analytic memos were used to bracket assumptions regarding productivity, efficiency, and technological benefits. During interviews and analysis, attention was directed toward participants' descriptions rather than the researcher's expectations about multi-screen work. This reflexive process supported interpretive transparency and strengthened alignment with the study's phenomenological orientation.

4. Results

The findings of this study are organised around four main themes that emerged from the analysis of interview data: dual monitors as tools for organisation and perceived workflow smoothness; emotional and identity-based perceptions; strategic use of monitors for academic tasks; and ergonomic, hardware, and software strategies. The findings demonstrate how dual-monitor setups support both planning (RQ1) and the application of task strategies (RQ2). The results emphasise participants' lived experiences and perceptions of how dual-monitor setups shape their planning and task strategy use. This analytic focus aligns with the phenomenological orientation and centres on participants' meaning-making processes.

Table 1 provides an overview of the characteristics of the eleven graduate students who participated in the study. The participants represented diverse academic qualifications, including Master's, PhD, and professional doctoral degrees. They came from a variety of disciplines, including Civil Engineering, Communication, Electrical Engineering, Geography, Osteopathic Medicine, Palaeontology, Higher Education Leadership, Health Administration, Microbiology, and Computer Science. The gender distribution among the participants was 8 males and 3 females. This diversity in participant characteristics ensured that the study captured a broad spectrum of experiences with dual-monitor use in different academic contexts, supporting the identification of both shared patterns and contextual variation across disciplines.

Table 1
Participant characteristics.

Participant ID	Gender	Academic qualification	Major
Participant 1	Male	Master's	Civil Engineering
Participant 2	Male	PhD	Communication
Participant 3	Male	Master's	Electrical Engineering
Participant 4	Male	Master's	Geography
Participant 5	Male	Doctorate	Osteopathic Medicine
Participant 6	Male	PhD	Palaeontology
Participant 7	Female	PhD	Higher Education Leadership
Participant 8	Female	Master's	Health Administration
Participant 9	Female	PhD	Microbiology
Participant 10	Male	Master's	Civil Engineering
Participant 11	Male	PhD	Computer Science

4.1. Dual monitors as tools for organization and perceived workflow smoothness

Participants emphasised that dual monitors were integral to managing their academic work in ways they perceived as smoother and more coordinated, and keeping resources organised. They described how separating tasks across two monitors allowed them to manage multiple sources of information without losing focus or becoming overwhelmed.

> A lot of my paper, a lot of my assignments are research papers. So I need to have the paper I'm writing on one side, and my references on the other monitor. (Participant 3)

This approach of dividing resources across monitors was echoed by others who highlighted the ease of managing writing and references simultaneously.

> You can open the research paper in one, and you have your Word document on the other one. (Participant 10)

The ability to allocate distinct tasks to each monitor extended beyond writing. Students described using dual monitors to balance technical work, note-taking, and reference materials, which they said helped them maintain order and continuity in their workflows.

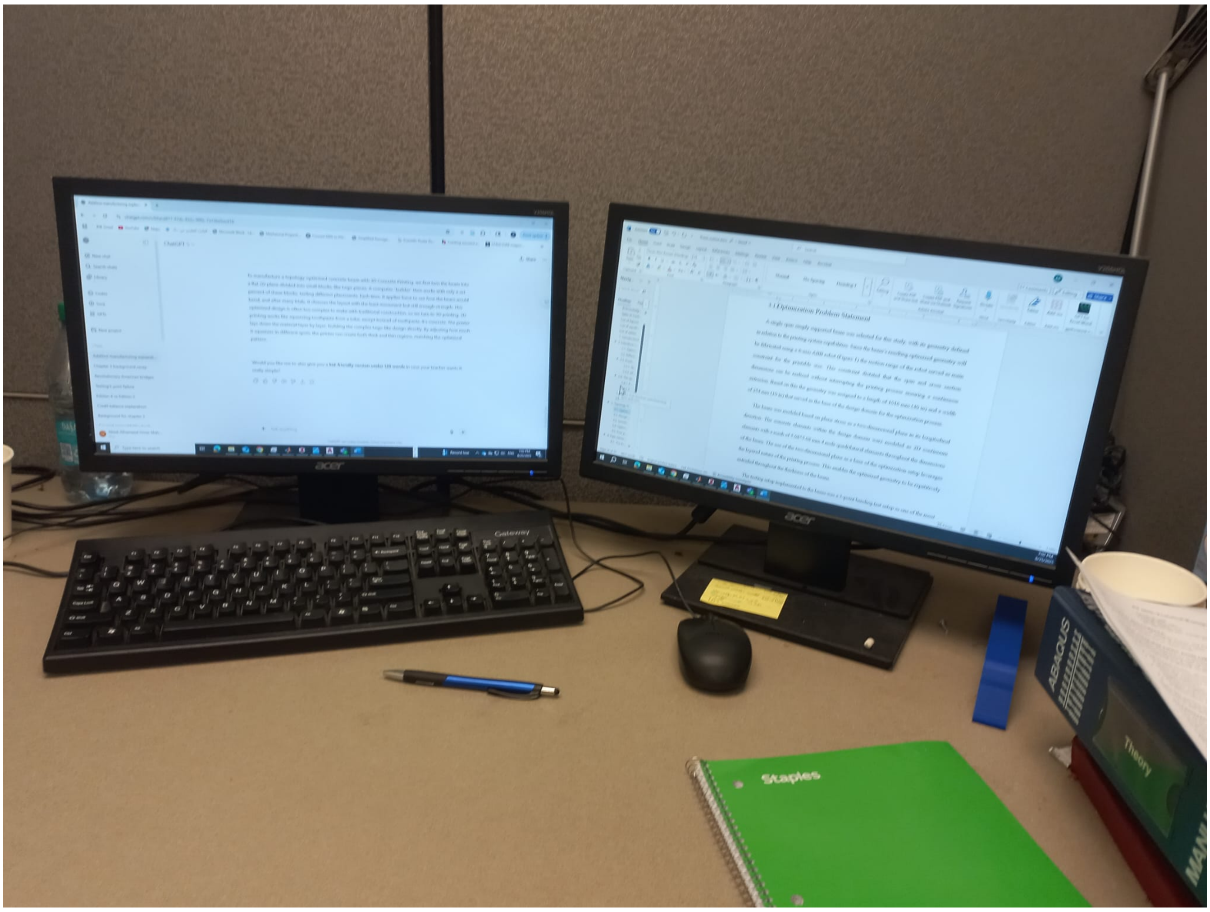

Figure 1: Example of a dual-monitor academic workspace used by study participants.

> On my first Monitor, I open a book, on my second monitor, I have codes and backup documents, so I don't lose track. (Participant 1)

Similarly, medical students described structuring their study sessions by separating key resources across screens.

> I usually start with one monitor, then open Google Chrome or Internet Explorer. I'll set up a tab with my questions and another tab with the medical journal where the questions come from. Once both are open, I drag the medical journal tab onto my second monitor, keeping the questions on the primary screen. (Participant 5)

Across these accounts, students noted that dual monitors not only kept resources in view but also reduced stress and clutter. Switching between windows on a single monitor was disruptive, whereas using two monitors improved focus and minimised distractions, as participants experienced.

> When I have one monitor, I feel very trapped... When I have more than one monitor, I feel like I can have all my thoughts lined up in a very succinct way. (Participant 2)

> If I were only using one monitor, like just on the laptop, I would miss things, or it would feel too cluttered. It would be more stressful to only work on one monitor. (Participant 3)

Taken together, these experiences illustrate how dual-monitor setups serve as organisational tools, enabling students to structure their work more effectively, manage multiple resources simultaneously, and experience lower levels of perceived stress in cluttered digital spaces.

4.2. Emotional and identity-based perceptions

In addition to organisational benefits, participants highlighted the emotional and identity-related dimensions of using dual monitors. Many described the setups as contributing to a sense of control and perceived regulation of stress and emotional load in their academic work.

> I feel less stressed with it. I keep one monitor as my 'spare', so it stays clean without any clutter, whereas the other monitor is a mess, a reflection of what's inside my brain. (Participant 7)

Dual monitors also appeared to strengthen feelings of confidence and competence. For some, the ability to spread resources and maintain an organised workspace translated directly into a sense of academic assurance and greater perceived readiness to engage with complex tasks.

> I definitely feel more in control and more confident. Having everything organised and laid out efficiently adds to that confidence. (Participant 8)

At the same time, the absence of a second monitor was often associated with frustration and perceived reductions in effectiveness. Participants described becoming irritated or stressed when forced to work without dual monitors, particularly when tasks demanded multiple resources.

> If I don't have a second monitor and I have to do something that requires one, I'm just going to be pissed about it, and I'll probably not work as effectively. (Participant 11)

Overall, students framed dual-monitor setups not only as functional tools but also as sources of emotional regulation and professional identity. They were described as providing reassurance, supporting participants' perceptions of smoother task engagement, and contributing to feelings of control and confidence in their academic roles.

4.3. Strategic use of monitors for academic tasks

Participants described how they strategically allocated tasks across their monitors, tailoring their setups to the specific demands of academic work. Rather than passively using dual monitors, students articulated intentional decisions about how to distribute attention, representations, and task components across monitors.

> One of the software programs I use requires me to visualise my map on one screen while adjusting parameters or using pop-up windows on another. (Participant 4)

> I'm looking at my specimen, displayed as a photograph or 3D model on one monitor, while reviewing a paper on the other that describes a similar object or specimen. (Participant 6)

For several participants, this task allocation was directly linked to perceived improvements in workflow smoothness and task coordination. Being able to keep multiple resources open simultaneously was described as reducing the subjective burden of switching between windows and supporting smoother engagement with complex academic processes.

> It has been a huge help and made life a lot easier because I can have two things open at once. I think it has really increased my productivity. For example, just last Friday, I was finishing a collaboration with another lab that asked me to run an analysis. I had to complete four sets, which might have taken about five hours on a single monitor, but with the dual-monitor setup, I finished all four in less than three hours. (Participant 9)

While participants occasionally cited time savings, these accounts primarily reflected their perceptions of smoother task execution and fewer cognitive interruptions, rather than objective measures of productivity. Students emphasised that dual monitors allowed them to maintain visual continuity across task elements, which they experienced as supporting focus and strategic control during task performance. Taken together, these examples illustrate how students adapted their use of monitors to fit the task at hand. Dual monitors were not used uniformly but rather strategically, allowing participants to divide, coordinate, and execute tasks in ways they experienced as more manageable, coherent, and fluid, as they experienced and described, in ways that a single monitor could not support.

4.4. Ergonomic, hardware, and software strategies

Participants also emphasised how their hardware choices and workspace organisation shaped their experiences with dual monitors. Ergonomics played a central role in how they arranged their setups, particularly regarding comfort, sustained attention, and the regulation of visual focus during extended academic tasks.

> I keep my main work, what I'm writing or typing, directly in front of me, and then I can glance to the right to reference PDFs, articles, or assignment instructions. That's why I set up my monitors in a straight line. It's more ergonomic because I can type while facing forward, rather than looking off to the side. (Participant 9)

Participants described these arrangements as supporting reduced physical strain and a more stable attentional orientation, allowing them to remain engaged with mentally demanding tasks for longer periods without discomfort or frequent posture shifts.

Beyond physical setup, others described customising their software environments to better suit their needs, based on task demands and individual preferences.

> I use a tiling window manager called XMonad, which lets me customise how my windows are arranged. I've set up different modes; sometimes I use a single full-screen window, other times I divide the screen so one side is larger and the other holds multiple smaller windows. I also have it set so that when I focus on a side window, it temporarily enlarges. While I mostly use the full-screen mode, the tiled layouts are helpful when I need to reference several sources at once, like books, papers, or forum posts. (Participant 11)

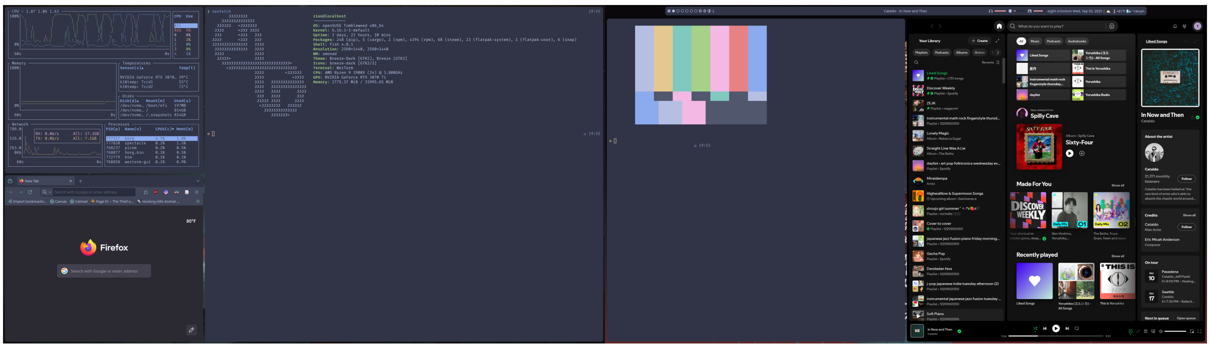

Figure 2: Example of window-management software used by a participant to organise digital resources across monitors.

Such accounts illustrate how participants employed specialised software tools to manage visual complexity, selectively allocate attention, and adapt display configurations in response to changing task demands. These configurations supported dynamic shifts between focused work and comparative referencing, which participants experienced as facilitating more seamless cognitive transitions during academic tasks.

Taken together, these accounts illustrate how students extended dual-monitor setups beyond basic functionality by actively shaping both physical and digital aspects of their workspaces to support comfort, focus, and task coordination. Rather than treating dual monitors as fixed tools, participants described adaptive and intentional configurations that aligned with their personal working styles and moment-to-moment task demands.

Such adaptations highlight how dual monitors became integrated not only as tools associated with productivity discourse but also as personalised systems for regulating attention, reducing physical strain, and maintaining engagement during complex academic work.

5. Discussion

This study provides new insights into how graduate students perceive and apply dual-monitor setups in their academic work, particularly regarding SRL. By examining participants' lived experiences, the findings highlight how dual monitors function not merely as technical tools but as experientially meaningful supports for planning, task coordination, and regulation during academic work.

Graduate students consistently described dual monitors as tools that supported the organisation and management of their academic work. By distributing tasks across monitors, students were able to keep writing, references, and supporting resources visible simultaneously, which participants associated with reduced digital clutter and smoother engagement with complex tasks. These findings show that dual monitors are not only convenient but also facilitate self-regulated learning, particularly in planning and structuring workflows, as students perceive and articulate in their lived academic experiences. Similar to Li et al. [36], who highlight the importance of examining the task environment for effective planning, students' use of dual monitors reflects intentional resource structuring to reduce friction in their work.

The significance of these results lies in the participants' perceptions of reduced mental strain and improved workflow continuity, which are enabled by parallel access to resources. Participants' descriptions of clutter and stress with a single monitor underscore the importance of environmental structuring, consistent with evidence that deliberate workspace organisation improves focus and reduces distractions [40]. Building on earlier studies that emphasised efficiency benefits in professional contexts [11, 60], this study shows that in academic contexts, dual monitors are also perceived as supporting workflow coordination and attentional continuity, thereby improving focus and workflow stability.

Students also emphasised the emotional and identity-based dimensions of working with dual monitors. They described feeling more confident, less stressed, and more in control when their setups functioned smoothly. In contrast, the absence of a second monitor was associated with frustration and a perceived reduction in effectiveness. These experiences highlight that dual monitors are not only functional tools but also a support for affective regulation, helping students manage stress and maintain confidence in their academic work.

The significance of this finding also lies in the way technology becomes integrated into students' identities as learners and professionals. For some participants, the monitor setup served as a core tool in their discipline, shaping both how they approach and manage academic tasks and their self-perception. This echoes evidence that ownership and control of the workspace strongly influence engagement and performance [1]. Moreover, the stress-reducing role of dual monitors aligns with prior work on environmental structuring as a strategy for reducing distractions and sustaining performance [70]. Thus, beyond technical efficiency, dual monitors serve as affective and identity-based resources that help students maintain regulation in demanding academic contexts, as reflected in their narratives. In addition, from an SRL perspective, these affective dimensions are critical, as emotional regulation is closely intertwined with learners' capacity to sustain effort and persist through demanding tasks.

Dual monitors also supported students' task-specific strategies, particularly when academic work required managing complex or simultaneous processes. Participants described using one monitor for visualisation or primary work, while reserving the second for reference materials, pop-ups, or collaboration. This arrangement was consistently linked to greater participants' perceptions of workflow smoothness and task coordination, and to reduced disruption from window switching, with some noting reduced task completion time when using two monitors compared to one.

These findings suggest that dual monitors facilitate performance-phase strategies by allowing students to break down tasks into components and manage them in parallel. Such practices resonate with research emphasising the role of technology in enabling learners to strategically align their actions with academic goals [62] and sustain volitional control during performance [8]. The perception that dual monitors improve productivity also reflects earlier work showing how expanded screen space reduces window switching and streamlines workflows [60]. In this way, students' experiences position dual monitors as not only practical tools for multitasking but also as experientially meaningful tools that support the enactment of task strategies within SRL.

Students also highlighted how dual monitors intersected with ergonomic and hardware strategies that shaped their learning environments. For example, some structured their workspace to minimise strain by aligning monitors in a straight line, enabling forward-facing typing while referencing additional material. Others emphasised software and hardware customisation, such as tiling window managers or custom keyboards, which allowed them to configure displays and input tools to match their workflows. These adaptations reflect students' efforts to minimise friction and maintain focus during academic tasks.

The significance of these practices lies in how students deliberately structured their environments to support self-regulated learning. Such environmental structuring has been identified as a key performance-phase strategy, enabling learners to sustain attention and limit interruptions [40, 70]. Moreover, by tailoring both physical and digital setups, students aligned with broader evidence that technology fosters SRL when it is integrated in ways that enhance organisation and minimise distractions [29]. The findings demonstrate that for some learners, dual monitors were not just tools for efficiency but part of a larger system of ergonomic and technological adaptations designed to sustain workflow and focus as experienced and described in their lived academic practices.

From a theoretical perspective, this study extends SRL scholarship by conceptualising multi-screen configurations as environmental-regulation affordances embedded within the performance phase of self-regulated learning. While SRL models traditionally emphasise cognitive, metacognitive, and motivational strategies, the present findings highlight how spatial-technological configurations become part of enacted regulation. Dual-monitor setups functioned as tools through which learners structured attention, coordinated resources, and managed emotional load. In this way, the study reframes digital workspace organisation as an integral dimension of environmental structuring within SRL, expanding understanding of how technological affordances intersect with regulatory processes in higher education.

Importantly, the present findings describe perceived regulatory practices rather than measured enhancement of self-regulated learning or academic performance. While participants associated dual-monitor use with smoother workflow and improved coordination, this study does not establish causal effects on learning outcomes. The results, therefore, position dual monitors as supports for technology-mediated SRL practices as experienced by learners, rather than as empirically verified performance enhancers.

5.1. Limitations

Several limitations of this study should be acknowledged. First, the study relied on a small, institution-specific sample of graduate students, which limits the generalizability of the findings. Second, the data are based on self-reported experiences and perceptions, rather than objective measures of SRL, productivity, or cognitive load. While this study identifies perceived workflow benefits, it does not purport to map the underlying cognitive architecture or measure cognitive load directly. Future quantitative work is needed to map these experiential accounts to cognitive mechanisms. As such, claims regarding efficiency, cognitive effort, or performance should be interpreted as participants' subjective experiences rather than empirical outcomes. Third, while the study focused on the forethought and performance phases of Zimmerman's model, the self-reflection phase was largely absent from participants' accounts and was not systematically examined.

6. Conclusion

This study examined graduate students' lived experiences with dual-monitor setups in academic environments through the lens of self-regulated learning. Focusing on the forethought and performance phases of Zimmerman's SRL model, the findings show that students perceive dual monitors as tools that support planning, organisation, and the enactment of task strategies in academic work.

Across participants' accounts, dual-monitor setups were described as facilitating the organisation of resources, coordination of tasks, and management of complex academic demands. Students also highlighted emotional and identity-related dimensions of dual-monitor use, including feelings of control, confidence, and reduced stress, as well as frustration when access to a second monitor was unavailable. In addition, participants described how the strategic allocation of monitors, ergonomic arrangements, and hardware or software customisation supported their academic workflows by facilitating smoother task coordination and sustained focus.

This study contributes qualitative insights into how students interpret and experience dual-monitor use in their self-regulated learning practices. By foregrounding students' perspectives, the findings extend prior research on dual-monitor setups beyond productivity and cognitive-load metrics, shifting attention to perceived workflow smoothness, affective regulation, and strategy enactment within authentic academic contexts, and situate dual monitors within the broader context of technology-mediated SRL.

Several limitations should be acknowledged. The study focused on a small sample of graduate students from a single institution and relied on self-reported experiences, which limits the generalizability of the findings. Additionally, the study did not include objective performance measures or experimental comparisons between single- and dual-monitor conditions.

Future research may build on this work by examining undergraduate populations, comparing different multi-screen configurations, or employing mixed-method or experimental designs to investigate how dual-monitor use relates to specific learning outcomes. Future studies may also explicitly examine how learners reflect on, evaluate, and adapt their digital workspace over time, thereby addressing the self-reflection phase of SRL that was beyond the scope of the present study. Such work may further clarify how digital workspaces can be designed to support effective self-regulated learning in higher education.

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Ethics approval

This study received institutional ethical approval prior to data collection (IRB #IRB-FY26-7, Social Behavioral Institutional Review Board, expedited review, approved September 22, 2025). All participants provided informed consent prior to participation, and procedures were implemented to ensure confidentiality and anonymity, including the removal of identifying information from transcripts and photographs.

Data availability statement

The data supporting the findings of this study are not publicly available due to privacy and ethical restrictions under the approved Institutional Review Board protocol at Ohio University (IRB-FY26-7). De-identified excerpts may be available from the corresponding author upon reasonable request.

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