Exploring an Invisible Version Control Technique to Reduce the Cognitive Load of Research Workflows

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Abstract

Despite the cognitive demands of research workflow, a critical gap exists in research tools: they force a trade-off between usability and robust data safety. Consequently, researchers rely on manual file management, creating 'Version Chaos' (e.g., thesis_v1.docx, final_v5.docx) that imposes severe extraneous cognitive load. This friction stems from two systemic failures: a 'Skills Divide,' where secure tools like Git are too technical for non-STEM scholars, and a 'Connectivity Divide,' where unstable cloud platforms force a reliance on vulnerable offline word processors. To address this gap, the study employs a three-phase Design Science Research (DSR) mixed-methods approach. Data was collected via structured surveys (N=48) and open-ended questionnaires (n=15) and was evaluated using descriptive statistics and inductive thematic analysis. First, quantitative results established a baseline of workflow friction, proving that manual file management triggers 'Version Anxiety' and interrupts the Flow State. Second, the study designed a high-fidelity 'Local-First Automated Version Control' (LFAVC) prototype. Finally, qualitative narratives validated the prototype, and the prototype's "Invisible Versioning" successfully shifts the burden of workflow processes from the human to the machine. Then, its 'Velocity Analytics' provides the visual feedback necessary to sustain long-term motivation. The study concludes that future academic tools must provide automatic version control without requiring technical skills. Practically, these findings provide software developers and HCI designers with a clear framework to build accessible, low-stress writing environments that ensure local control over data and reduce researcher burnout.

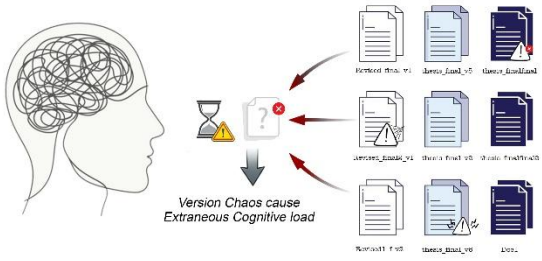
Keywords: Cognitive Load, Digital Divide, Human-Computer Interaction (HCI), Research Workflow, Version Control

INTRODUCTION

The academic writing process of workflow in an academic context needs extreme concentration on the synthesis of ideas. Computer word processors are the main tools that are used for this kind of task. Nevertheless, the management of files as an administrative activity tends to interrupt this creative process. According to Sweller (1988), Cognitive Load Theory states that the human working memory has a cognitive capacity. As a consequence, any additional activity, such as the management of files, uses part of the intellectual capacity needed for conducting research itself. This problem leads to a phenomenon called "Version Chaos." This refers to the confusing practice of manual naming and tracking multiple drafts (e.g., thesis_v1.docx, thesis_final.docx). This manual tracking forces researchers to constantly switch contexts, which reduces productivity (Renom, 2022; Reza et al., 2023). Additionally, the constant fear of losing data creates "Version Anxiety." This state of stress actively breaks a researcher's focus and flow (Gori et al., 2020).

Currently, a significant gap exists in academic research tools. Researchers are forced to choose between usability and data safety. Traditional offline word processors are easy to use but lack reliable version control. Conversely, professional developer tools like Git provide a free, open-source distributed version control system used primarily by software developers to track changes in their source code during development, offering data safety, but requiring complex coding skills (Chacon, 2026). This creates a "Skills Divide" that excludes non-technical scholars from using safe tools. Cloud-based platforms attempt to solve this with automatic saving, but they require a constant internet connection. This creates a "Connectivity Divide." It also raises concerns about data privacy and ownership in the era of AI surveillance (Seran et al., 2025).

Figure 1: Version Chaos and High Cognitive Load



Source: Developed by Researchers, 2026

This research will address these shortcomings by introducing and analysing a new theoretical model named "Local-

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First Automated Version Control" (LFAVC). Rather than testing a specific software application, this study explores the usefulness of 'Invisible Versioning,' a system that conceives the technical aspects of data preservation from users. Moreover, this model will include "Velocity Analytics," which would provide visual feedback regarding writing consistency (e.g., number of words written vs. number of words deleted). Based on Goal-Setting Theory, this would help researchers stay motivated for the workflow timeline during their academic endeavors (Campion & Lord, 1982).

The key research question of this study explores the influence of "Invisible Versioning" on the researcher's research workflow process. Through the Design Science Research (DSR) approach, the study tests the concept using a combination of qualitative and quantitative analysis. According to the hypothesis, the academic software should be seen as an "invisible agent." By isolating the security aspect from the complexity issue, version anxiety is minimized, and it also gives the researcher room to focus on developing knowledge and timelines. (MacLeod et al., 2012; Sterman et al., 2022).

LITERATURE REVIEW

The present section explores the challenges faced by researchers in the process of writing. Validation of the theory is based on extant theoretical knowledge derived from HCI, psychology, and information systems. The theory describes "version anxiety" and "extraneous cognitive load" and explains how "invisible versioning" and "velocity analytics" are effective.

Cognitive Load Theory and Administrative Overhead: According to the theory of Cognitive Load proposed by Sweller (1988), the memory of human beings has been said to be bound with strict limits. Although the earlier cognitive theories had distinguished three types of cognitive load, that is, intrinsic, extraneous, and germane; the more recent theories only include two kinds of cognitive load (Debue et al., 2020). In academic settings, Intrinsic Load is contingent upon the complexity inherent in the processing of the information presented. On the other hand, Extraneous Load results from bad task design, such as ineffective writing systems and "administrative drudgery" associated with file management (Akin & MurrellJones, 2018; Oliveira & De Barba, 2022). The burden of extraneous material directly affects the cognitive resources allocated to germane load, which plays a critical role in high-level cognitive activities such as organizing thoughts and making necessary changes to the argumentation process (Li & Zhang, 2021; Zhang et al., 2023). In that case, removing any unnecessary extraneous cognitive load can considerably improve a researcher's ability to conduct productive research.

According to Khan and Suhluli (2025), Generative AI systems are designed to reduce cognitive load; however, when they are not properly incorporated into technology, they can actually induce higher mental pressure. In research studies, manual processes such as repetitive "Save As" operations produce considerable "bad load." They force researchers to use working memory for tracking file states instead of creating knowledge (Akin & MurrellJones, 2018; Noroozi & Karami, 2022). By introducing "Invisible Versioning," researchers no longer consciously manage file states. This frees up limited working memory for the high-level cognitive tasks required for writing (Criado-Perez et al., 2024). This is in line with the need to free up cognitive resources for creativity and critical thinking, a necessary aspect for effective writing development (M. Li & Wilson, 2025).

Hayes and Flower Cognitive Process Model of Writing: The primary theoretical framework for understanding writing as a cognitive process driven by a specific goal is the Hayes and Flower Cognitive Process Model, as explained in Gero et al. (2022). This framework includes three non-linear stages of Planning, Translating, and Reviewing, regulated by an internal monitor, known as the "Monitor" (Karim et al., 2020; Sebit & Yildiz, 2020). In its updated version, a new "Resource Level," which includes physical transcribing media and the task environment, has been added to the framework (Kruse et al., 2023).

Where the "task environment" (software used) does not perform effectively, it results in bottlenecks at the "Control Level," where ideas need to be translated to text form (Kruse et al., 2023). Advocating for the "Local-First" model corresponds to this framework since it guarantees that the "transcribing technology" will always be functional, irrespective of the Internet connection, and hence prevents the "Connectivity Divide" from disrupting the recursive loop of planning and revising (Hofbauer et al., 2023; Jørnø, 2016). This strategy drastically cuts down the mental stress caused by technological limitations, making it easier for writers to maintain concentration on cognitive activities related to writing (Atasoy, 2023).

Self-Regulated Strategy Development and Velocity Analytics: The Self-Regulated Strategy Development model highlights how metacognitive processes like goal-setting and self-monitoring help increase success in writing (Klein & Boscolo, 2016). Studies have found that graphing oneself helps writers become more strategic and motivated in terms of their progress (Graham, 2021). "Velocity Analytics" promotes this through its ability to provide writers with objective feedback about their writing process. It thus facilitates adaptive self-regulation by making one's own progress clear and measurable (Mateo-Girona et al., 2025). Such information may allow writers to reflect on their approach to writing and modify it, improving their skills.

The "Velocity Analytics" tool is being recommended and essentially, for an "Automated Adaptive Scaffold" for SRSD (Fernandez & Guilbert, 2024). Through mapping out the "sprint potential" of a given writing task, akin to an effort estimation, Agile-automated feedback can be provided to researchers even through the prolonged "low feedback periods" encountered when undertaking a research paper (Pasuksmit et al., 2024; Sterman et al., 2022). The introduction of the feedback system converts the vague concept of "completing a paper" into tangible milestones that are easier to achieve and thus reduce the risk of burnout (Aenugu & O'Doherty, 2025; Tondello et al., 2018).

Data Sovereignty and the "Un-territorial" Nature of Research: In the age of cloud computing, academic information has increasingly become "un-territorial" in that it is often housed in several different places, resulting in issues regarding "exclusive authority" as well as confidentiality

(Kushwaha et al., 2020). The term Data Sovereignty can be defined as the capability of researchers to exercise complete authority over their own intellectual property (Kushwaha et al., 2020). Current web-based editors often force a trade-off between the benefits of cloud collaboration and the security of local storage (Hofbauer et al., 2023). By focusing on a "Local-First" approach, scientists can ensure the realization of "Invisible Versioning," yet still maintain total control of their data, reducing their fear of "AI Surveillance." (Kushwaha et al., 2020; Perzanowski, 2010). Such an approach will not only make the data protection procedure better but also lead to greater confidence and autonomy in using the online research system, especially since the research that scholars perform requires special attention because of its sensitive nature. The emphasis on the importance of local management and the ownership of data becomes very helpful in solving diverse problems faced by academic researchers, who need efficient systems to receive useful information (Xu et al., 2024). Additionally, combining such solutions with pedagogical approaches, including metacognitive strategies and self-efficacy, can increase their efficiency in enhancing writing performance (Stofiana et al., 2025).

Flow Theory and Version Anxiety: Flow Theory identifies "Deep Work" as an optimal state in which individuals are engaged in tasks that require a high level of concentration and experience a distorted sense of time (Kotler et al., 2022). Such a state is achieved when a balance exists between task difficulty and individual ability (Rampley et al., 2019). However, (International Advances in Writing Research: Cultures, Places, Measures, 2012) highlights that the ability to achieve a state of flow is vulnerable to interference from anxiety or other factors that may cause disorientation and tiredness. "Version Anxiety," which is recognized as a critical barrier to achieving a state of flow in document writing, is characterized as a fear of losing document versions and cognitive difficulties associated with manual version control systems (Henderson, 2011). The constant state of anxiety and concern over the possibility of overwriting a document or not having access to previous versions of a document takes the mind off the creative analysis of the subject matter and creates a disruption that breaks up the concentration required for high-level intellectual production (Gori et al., 2020; Ritonummi et al., 2024). Inefficient data management also contributes to this by creating a lack of trust in one's own data archives (Hunt & Bakker, 2018). Research has proven that secure settings allow people to remain engaged in their cognitive tasks because there is no fear of losing their data. The "just-in-case" approach makes researchers keep multiple versions of files just in case, leading to more confusion while searching for relevant data in the future. Such an approach creates a "hodgepodge of file names," and it becomes hard to determine which one is the latest or most appropriate version (Cohen-Adad, 2024; Gori et al., 2020).

Task-Technology Fit (TTF) theory suggests that technology has a positive effect on individual performance only when the fit between technological features and task specifications is high (Abdulrab, 2025; Khumalo, 2022). "Fit" will lead to better use of technologies and increase productivity, while "mismatch" means low efficiency and dissatisfaction (Iversen & Eierman, 2018; Shishakly et al., 2021). But the process itself has its problems. As an illustration, a word processor is made for general office use rather than for writing papers, and its version control features are too weak to enable more than one draft (Hofbauer et al., 2023). In particular, Git used by programmers is very complicated and hard to be used by those researchers who do not have any programming knowledge (Hofbauer et al., 2023). Besides, it is evident that it is an example of a misfit between the application and the software. In other words, it is necessary to find a solution that would help improve version control and facilitate software installation. This way, it would be possible for technology to work effectively and guarantee that the researcher concentrates on his work and not technology (Iversen & Eierman, 2018). As a result, technology would support research activities without causing any interference; hence, there would be no technostress (Vendramin et al., 2021).

Goal-Setting Theory: According to the Goal-Setting Theory, if people have a clear and challenging goal along with good feedback, they tend to improve their performance. This contrasts with the performance of people who have unclear goals. This theory also emphasizes the importance of feedback in improving performance. Feedback helps people see the progress they have made towards their goal, stay motivated, and change their strategies to reach the goal (Şenormancı, 2018). The process of writing a thesis is a long-term process that requires a lot of time. Sometimes, people who write them may not get immediate feedback on their work. This can result in the absence of motivation over time. "Velocity Analytics" that represents the progress of writing the thesis using different graphs, such as the number of words added or deleted daily. It is based on the Goal Setting Theory. This helps researchers become motivated by receiving feedback on their work. This type of analytics helps researchers set their smaller goals and feel a sense of accomplishment by completing small steps in this long writing process (Aenugu & O'Doherty, 2025; Tondello et al., 2018).

However, the combination of the above-mentioned four theories reveals a serious weakness in the workflow used in current research work. First, researchers find themselves at a crossroads between usability and security when using word processors, which leads to Version Anxiety, and using security software that leads to Skills Divide. In addition, the use of cloud computing poses the risk of data sovereignty.

To tackle this complex challenge, the current paper introduces the concept of Local-First Automated Version Control (LFAVC). "Invisible Versioning" operates behind the scenes. It removes the responsibility of organizing files from the human mind to machines, thus guaranteeing ownership over data within an offline context. Meanwhile, "Velocity Analytics" functions as an adaptive support system that applies the principles of goal-setting to supply the necessary visual stimuli required to sustain flow. After defining the theoretical need for such an approach, the next section outlines the method for gauging its desirability among practicing scholars.

MATERIALS AND METHODS

This study employs a mixed-method Design Science Research (DSR) framework in investigating administrative friction in academic processes and creating a feasible technological solution. DSR refers to a scientific problem-solving process aimed at enhancing human understanding through

the creation and testing of new artifacts (Hevner et al., 2004). In order to appropriately identify a problem, create a solution, and evaluate a solution's efficacy, three different yet sequential phases were conducted in this study.

Phase 1: Quantitative Needs Assessment

The goal of the first step was to empirically prove that the problem of workflow friction exists, and to measure "Version Anxiety," "Cognitive Load," and the divides that currently exist in existing software tools. Table 1 below illustrates how the survey questions map to theoretical constructs.

Population and Sampling: The target population involved active academics, who range from undergraduates to tenured professors. A convenient sampling of networks of academics was used to identify participants.

Inclusion Criteria and Stratification: The inclusion criteria for the respondents were that they be engaged in long-form academic writing (thesis/dissertation/journal publication) and, therefore, have issues with their workflows. In order to examine the "Skills Divide" theory, our population was stratified based on the Field of Study.

Instrument: For data collection, we made use of a questionnaire available online via Google Forms. Our instrument contained 14 quantitative questions answered using a five-point Likert scale (1-Strongly Disagree; 5-Strongly Agree).

Table 1: The Survey Items were Designed to Operate the Theoretical Frameworks Established in The Literature Review

Variable	Theoretical Basis	Survey Mapping
Cognitive Load	Cognitive Load Theory	Measured by the rate of manual file management activities (e.g., "Save As" operations).
Version Anxiety	Flow Theory	Measured by the level of stress experienced regarding data loss and/or failure of data retrieval.
Technical Barrier	Digital Divide	Measured by the perceived difficulty of adopting professional tools like Git.
Perceived Usefulness	Task-Technology Fit (TTF)	Measured by the desirability rating of proposed features (Invisible Versioning, Velocity Analytics).

Source: Developed by Researchers, 2026

Analysis Plan: Data cleaning, descriptive statistical computations (Mean μ and Standard Deviation), and gap analysis were conducted using the Python programming language within the Google Colaboratory (Colab) environment using the pandas library. During this phase, Google's Gemini was used as a pair-programming assistant to enhance the development and debugging process for the Python scripts for carrying out the above statistical analysis and visualization. It should be understood that, despite using this AI-enabled technology for efficient coding, all the code and output statistics have undergone rigorous verification by the author before their use in this paper. The proposed LFAVC framework is presented solely in a conceptual manner.

Phase 2: Artifact Design and Prototyping

Considering the empirical gaps identified during the first phase, the second phase consisted of the conceptualization and development of the solution artifact, which is the Local First Automated Version Control (LFAVC) framework. Rather than evaluating the theoretical concept, the researchers developed a high-fidelity software prototype to physically demonstrate the application of psychological theories to the design of the user interface (UI).

The prototype was designed to operate two core features:

- Invisible Versioning (Cognitive Load): Simplifying the process of terminal-based versioning by providing an automatic, visual representation of the version timeline, thus reducing cognitive overload on users.
- Velocity Analytics (Goal Setting Theory): Providing a visual dashboard with graphs for tracking writing velocity, i.e., words written versus words erased, to keep up with motivation.

Phase 3: Qualitative Concept Validation

The final phase evaluated the perceived usefulness and psychological impact of the proposed LFAVC prototype.

- Data Collection: A subset of the original survey participants (n=15) opted to complete an extended qualitative narrative questionnaire. Participants were presented with the conceptual mechanisms of the prototype and asked to describe how such a system would impact their daily writing routine and anxiety levels.
- Analysis: The open-ended narrative responses were evaluated using inductive thematic analysis (Braun & Clarke, 2006). This qualitative stage extracted core themes regarding information overwhelm and validated how the automated architecture successfully mitigates the friction identified in Phase 1.

Methodological Limitations: The study relies on self-reported data, which may be subject to recall bias regarding the frequency of past data loss events. Furthermore, as a concept validation study within a DSR framework, the qualitative results reflect the perceived usefulness of the high-fidelity prototype rather than post-implementation user metrics from a live, long-term software deployment.

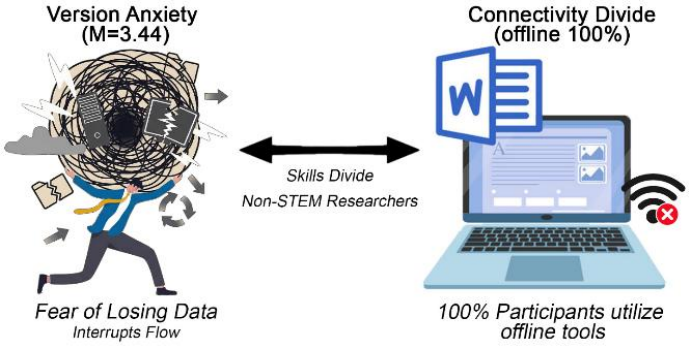
RESULTS AND DISCUSSION

Results

The findings from the mixed-methods survey were conducted with academic researchers. The quantitative phase (N=48) measured the pervasiveness of administrative friction and evaluated the desirability of the proposed framework. The qualitative phase (n=15) utilised open-ended narratives to provide a deeper context. The results are structured to identify the nature of workflow friction, the systemic infrastructure limitations causing it, and the validation of the conceptual framework designed to resolve it (see Figure 2).

Phase 1: Quantitative Needs Assessment

Figure 2: Conceptual Mapping of Workflow Frictions and Systemic Divides

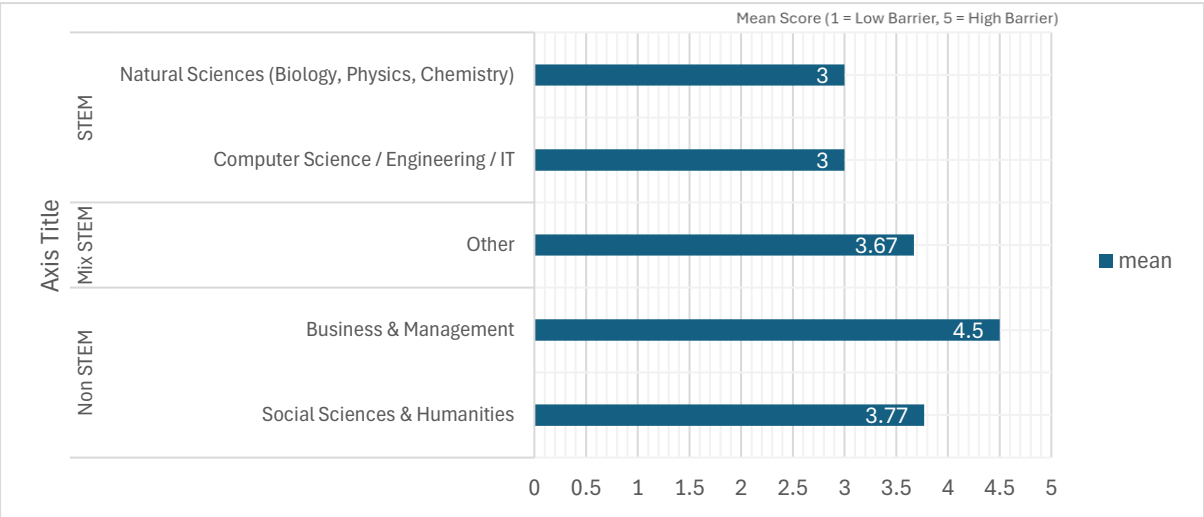


Source: Developed by Researchers, 2026

The "Skills Divide" and Task-Technology Fit: To test the hypothesis of the "Skills Divide" in academic tooling, the researchers were grouped according to their field of research and asked to rate the level of technical difficulty of industry-standard version control systems such as Git.

The data indicate strong evidence of the existence of a 'Skills Divide' in the field of academics in a technical sense. There was significant agreement among researchers from Business ($\mu = 4.50$) and Social Sciences ($\mu = 3.77$) disciplines regarding the issue that 'the tool was too technical or distracting' in the area of 'creative writing.' Researchers from Computer Science/Information Technology and Natural Sciences disciplines gave neutral responses ($\mu = 3.00$). As evident from the illustration in Figure 3, there is strong support for the existence of "Skills Divide."

Figure 3: Mean Technical Barrier Scores by Academic Discipline.

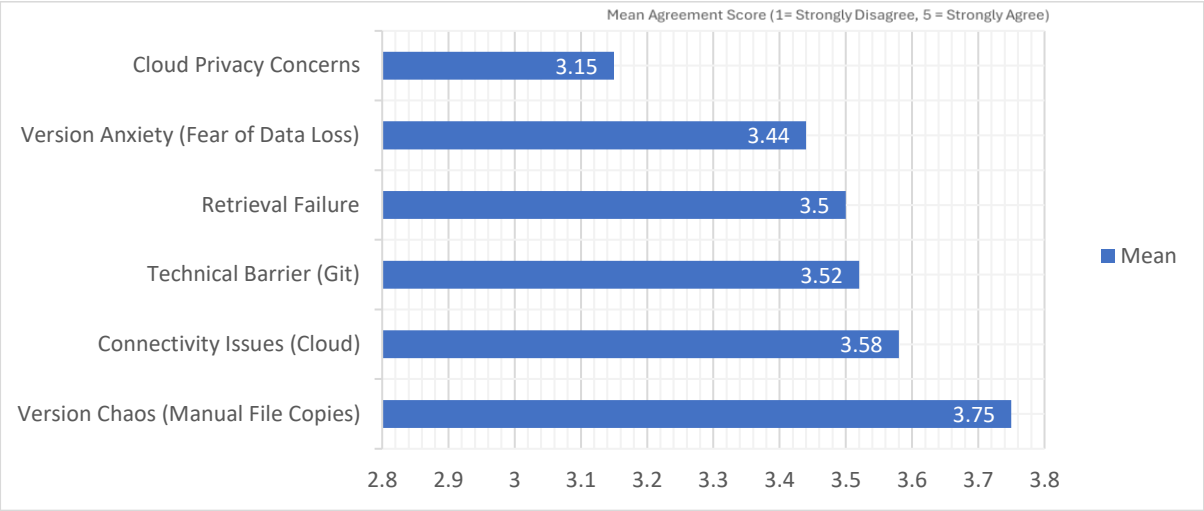


Source: Developed by Researchers based on Survey Data, 2026

This serves to confirm the task-technology fit (TTF) hypothesis. While Git offers effective data security features, the technology is poorly suited for use by non-technical academics who focus primarily on writing texts rather than coding. The mental strain associated with using command-line interfaces prevents academics from focusing on their work, emphasizing the need for visual interfaces once more.

Quantification of Workflow Friction and Cognitive Load: In order to measure the constructs of Cognitive Load and Version Anxiety, the entire sample (N = 48) evaluated their existing workflow difficulties (see Figure 4)

Figure 4: Severity of Workflow Friction Points



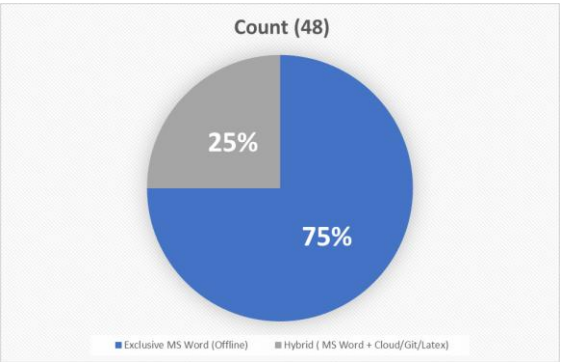
Source: Developed by Researchers based on Survey Data, 2026

The Nature of Workflow Friction: This finding highlights the prevalence of manual handling of files as one of the main sources of friction in the workflow. Researchers rated "Version Chaos" the manual copying and renaming of files (e.g., thesis_final_v2.docx) - as the highest friction point in their workflow (μ=3.75). This administrative burden was strongly correlated with "Version Anxiety" (μ=3.44), representing a constant fear of data loss.

The Systemic Tooling Divides: According to the results from the surveys, it is evident that researchers fall victim to these suboptimal workflows because of the huge disparity in tools available. There appear to be two types of divides here – the Skills Divide and the Connectivity Divide.

Statistically, non-STEM scholars (Business μ=4.50; Social Sciences μ=3.77) found professional software development tools such as Git to be a significant technical hurdle. Moreover, all respondents admitted that they relied on offline word processors such as Microsoft Word due to the challenges associated with accessing the cloud (Figure 5).

Figure 5: Primary Text Editor Usage Among Participants



Source: Developed by Researchers based on Survey Data, 2026

The high mean value in internet-related problems (μ = 3.58) indicates that the cloud dependency problem is one of the "Connectivity Divide" issues among many researchers. When the use of intellectual properties depends on a stable internet connection, it generates lots of stress and worry. In addition, the medium value concerning the fear about data privacy in commercial clouds (μ = 3.15) indicates the necessity of Data Sovereignty.

Phase 2: Artifact Design and Prototyping (The LFAVC Framework)

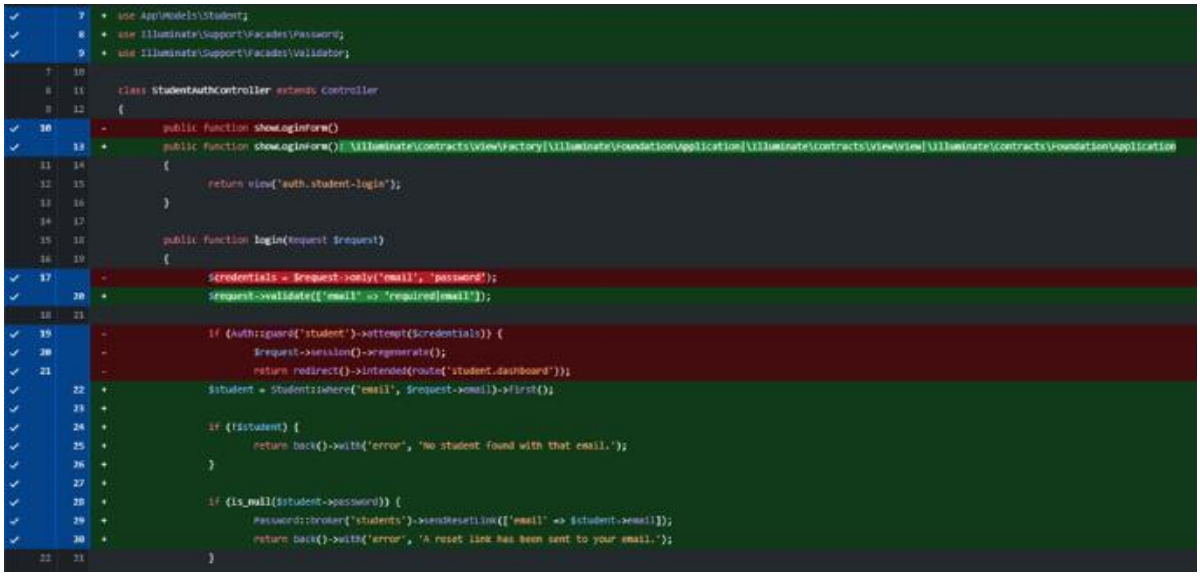
To address the issues identified in Phase 1 concerning workflow friction and institutional divides, the researchers created a high-fidelity conceptual prototype. The prototype serves as an implementation of the LFAVC model, providing an actual space in which to test whether particular UI design considerations can help overcome the underlying psychological barriers associated with academic writing.

The prototype's technical structure was built based on the psychological requirements identified through the literature review.

Abstraction of Complexity, "Invisible Versioning" and Cognitive Overhead: It was clear from the numerical results presented above that the use of professional tools such as Git would make the attainment of an "Invisible Skills Divide" inevitable for non-STEM researchers. As mentioned before, version control in its traditional format involves the manual entry of command-line commands into a terminal window interface.

In order to address this, the LFAVC prototype has developed the concept of "Invisible Versioning." It is designed to function completely in the background, allowing the program to take detailed snapshots of the document every time the user pauses typing. In essence, the extraneous cognitive load will be managed by the program and left to the execution by machines, enabling the individual to concentrate on 100% of the intrinsic cognitive load associated with the writing process. The visual representation of how the Extraneous Cognitive Load decreases using the Git interface and an automated sidebar is shown below (Figure 6 & Figure 7).

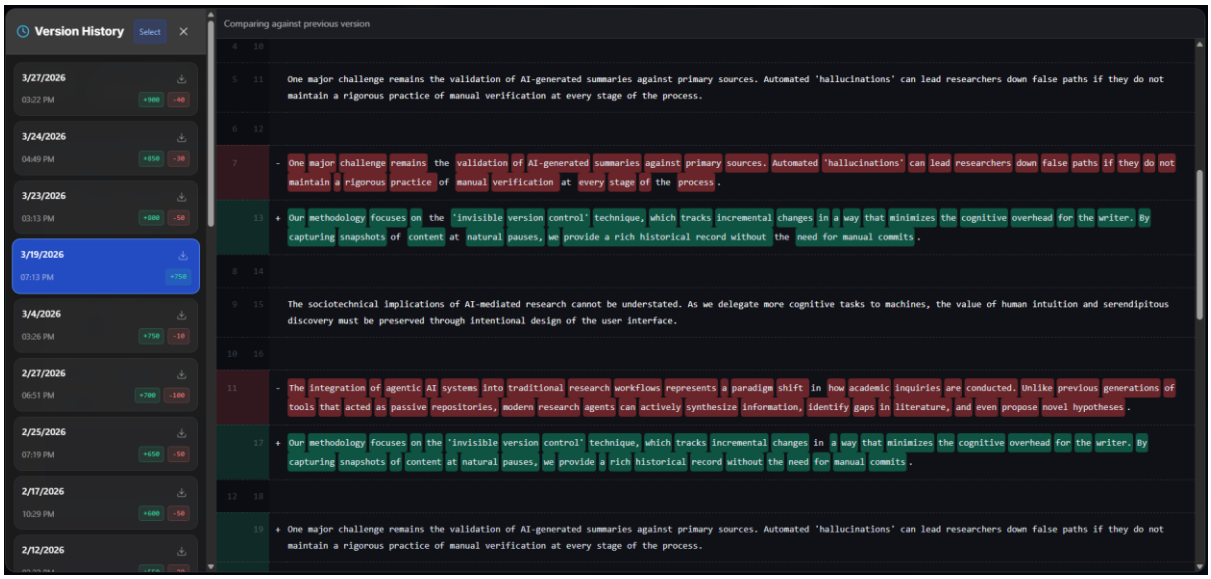
Figure 6: Traditional Git Interface



```
+ use App\Models\Student;
+ use Illuminate\Support\Facades\Password;
+ use Illuminate\Support\Facades\Validator;

class StudentAuthController extends Controller
{
-       public function showLoginForm()
+       public function showLoginForm(): \Illuminate\Contracts\View\Factory|\Illuminate\Foundation\Application|\Illuminate\Contracts\View\View|\Illuminate\Contracts\Foundation\Application
        {
                return view('auth.student-login');
        }

        public function login(Request $request)
        {
-               $credentials = $request->only('email', 'password');
+               $request->validate(['email' => 'required|email']);

-               if (Auth::guard('student')->attempt($credentials)) {
-                       $request->session()->regenerate();
-                       return redirect()->intended(route('student.dashboard'));
+               $student = Student::where('email', $request->email)->first();

+               if (!$student) {
+                       return back()->with('error', 'No student found with that email.');
+               }

+               if (is_null($student->password)) {
+                       Password::broker('students')->sendResetLink(['email' => $student->email]);
+                       return back()->with('error', 'A reset link has been sent to your email.');
                }
```

Source: Developed by Researchers based on Programming Code, 2026

Figure 7: The Proposed LFAVC "Visual Time Machine" Interface



Source: Developed by Researchers, 2026

The Visual Timeline - Mitigating Version Anxiety to Re-establish the Flow: In order to overcome this problem, the LFAVC interface abandons the practice of storing individual files separately and adopts a central "Visual Time Machine."

As shown in Figure 8 below, the contributions made by the researcher are displayed using a holistic contribution graph that keeps track of the researcher's daily writings for an overview of the entire year (for instance, displaying 2855 contributions in 2026).

Figure 8: The LFAVC Prototype's Automated "Visual Time Machine" Interface



Source: Developed by Researchers, 2026

The Visual Timeline - Reducing Version Anxiety to Enable Flow: During Phase 1 of the assessment, it was found that manual file naming protocols (such as thesis_final_v2.docx) lead to a "Version Anxiety," which effectively breaks the Flow State from a psychological perspective. In order to solve this problem, the LFAVC UI avoids individual file keep-

ing and instead opts for a more integrated "Visual Time Machine". As seen in Figure 1 above, older versions of the text are not kept individually, but are instead displayed within a consistent chronological timeline right next to the text editor itself. This is what enables the researcher to feel completely confident knowing that everything will be recorded, and nothing will be lost – giving complete psychological protection against any version anxiety. As a result, the researcher's mental effort to preserve data integrity is minimized, making it possible to continue working through "Deep Work" necessary for maintaining a Flow State.

Velocity Analytics, Operationalizing Goal-Setting Theory: Scholarly writing is a lengthy process that often faces the challenge of having no instant feedback, thus causing burnout. To counteract this problem, the prototype uses "Velocity Analytics," which is an interactive dashboard that has been developed based on Goal Setting Theory (Campion & Lord, 1982). Figure 9 depicts how the dashboard offers instant visual feedback regarding the flow of writing on a daily basis.

Figure 9: The "Velocity Analytics" Dashboard within the LFAVC Prototype, Providing Daily Visual Feedback on Writing Momentum



Source: Developed by Researchers, 2026

In order to decompose this momentum even more, the system offers a very detailed breakdown in terms of manuscript creation. As depicted in Figure 10, the analytics engine is able to break down word counts and percentage breakdowns at the chapter level.

Figure 10: Chapter Distribution with Word Count and Percentage (%)



Source: Developed by Researchers, 2026

Moreover, the software tool is not simply a passive text editor but also an active motivational agent that tracks the consistency in writing. This is shown in Figure 11, where the interface motivates through objective real-time feedback in terms of how many "words added" and "words deleted."

Figure 11: The Writing Consistency/Words Added vs. Deleted



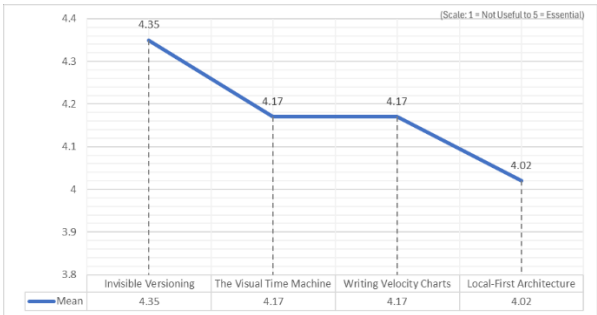
Source: Developed by Researchers, 2026

As compared to the software functioning as a passive text editor, the LFAVC framework serves as a motivating entity for the researchers. The analysis of the data through the dashboard helps the researchers in getting objective feedback on their progress, classifying their data into two categories: "words added" and "words deleted." With the visualization of their sprint capability, the daunting task of "completing a thesis" turns into an easily accomplishable daily target for the researcher.

Validation of the Conceptual Framework: To overcome these divisions, a discussion regarding the acceptability of the "Local-First Automated Version Control" (LFAVC) framework was conducted by the respondents. The quantitative

data showed overwhelmingly high validation for the proposed features: "Invisible Versioning" (μ=4.35), "Velocity Analytics" (μ=4.17), and "Local-First Architecture" (μ=4.02) as summarized in Figure 12.

Figure 12: Perceived Usefulness of Proposed System Concepts



Source: Developed by Researchers based on Survey Data, 2026

The feedback on the proposed conceptual framework was overwhelmingly positive. The most pressing need was for "Invisible Versioning" (μ = 4.35), which illustrates the need for researchers to have one source of truth that can safely automate their data, without the need for them to ever touch it technically. Moreover, the high validation of "Writing Velocity Charts" (μ = 4.17) has a direct correlation with the proposed Goal-Setting Theory. The proposed conceptual framework will give the researcher a much-needed feedback mechanism that will keep the researcher motivated, as with capacity management in Agile software development methodologies. The high validation for "Local-First Architecture" (μ = 4.02) answers the researcher's need for connectivity and privacy, showing how much this feature is needed for the new academia.

Phase 3: Qualitative Concept Validation

The final phase of the results aimed to validate the efficacy of the artifact, as conceptualised with the LFAVC prototype. The open-ended survey responses received (n = 15) were analyzed through an inductive thematic analysis approach (Braun & Clarke, 2006) to determine the perceptions of the researchers regarding the proposed features regarding the friction in the researchers' workflow. Three dominant themes were found, validating the design choices made with the prototype.

The qualitative thematic analysis of Question 1 corroborated the statistical results. Respondents consistently highlighted that manual versioning creates an interference in their work. The next four quotations support this view:

Researcher 01:

"I normally save these as either file1, file2, or final1, final2. There were cases, however, when I had encountered a problem using these versions. This is because if, by any means, I conduct an urgent search where the wrong file is used, then there will be a need to search again for my files separately. This would be a hassle! Imagine doing a submission where the wrong file should be submitted during a deadline; surely this is risky."

Researcher 02:

"There is a challenge that comes from working with multiple files that have similar names, as it can be difficult to locate the right version. This may result in delays in my work process, and I may end up working on the wrong file by mistake."

Researcher 03:

"Rather than concentrating on what I have been writing, I end up stopping to check if I have the right file name or even the right folder to save it in."

Researcher 04:

"I've found myself having trouble making versions such as 'draft_v1', 'draft_final', 'final_revised', and 'final_final'. There were instances where I would open a different version and modify it before saving the updated version. Thus, some crucial modifications were not saved."

The stories proved the need to develop the artifact on a Local-First platform compared to cloud-based autosave (such as Google Docs). The participants continuously pointed out the "Connectivity Divide." They believe that true peace of mind is achievable offline.

Researcher 01:

"I personally use MS word office package offline to type using Word because it is installed on my computer. This is why I use it. Never heard of 'Git' before. I don't usually use apps like Google Docs because sometimes my internet connection isn't that good. In those cases, it's convenient for me to type on the computer at some point. I've used Google Docs a few times. But I find the offline MS Word application more convenient."

Researcher 02:

"I choose Microsoft Word for academic writing since it can function without any internet connectivity and also has easy accessibility. I just need to open it, and I can start writing without any internet connectivity. On the other hand, applications such as Google Docs require good internet connectivity, and at times, it takes time to connect to the internet. Moreover, I do not know about Git or its working."

Researcher 03:

"Nevertheless, it comes with its weaknesses like no real-time backup facility, restricted access through other gadgets, and at times, there might be a problem with file corruption."

Researcher 04:

"A key issue is the inability to access documents from different locations, along with the difficulty of recovering files if they are accidentally lost."

Psychological Relief with "Invisible Versioning": While assessing the prototype's automated background operation, all research participants unambiguously stated that abstracting version control from direct human interaction will drastically decrease their Extraneous Cognitive Load. There was a clear feeling of psychological relief when "Save As" cycles were no longer necessary.

Researcher 01:

"An automatic local saving feature will enhance my trust while typing."

Researcher 02:

"Not only will it save me from possible risks like sudden power failure and computer breakdown, but it will also free me up to think more about my ideas rather than saving documents."

Researcher 03:

"An automatic background saving function will be safer and less stressful for writing."

Researcher 04:

"Besides preventing the loss of data and minimizing worries while creating and comprehending the document."

There was also strong qualitative support for incorporating the visual analytics dashboard in the prototype design. The Goal-Setting Theory hypothesis was validated by participants, who believed that the visualization of their "sprint capacity" would revolutionize their attitude towards long-term academic papers.

Researcher 01:

"In case these options were made available to me, they might assist me in tracking my productivity, learning about my own writing styles, and remaining motivated because of the tangible progress I have seen."

Researcher 02:

"To know about my modifications, including deletions and insertions of any text, might make my revisions easier for me. And since I am writing a thesis, it means that I have to document my thesis in the long run."

Researcher 03:

"Motivation will go up (I will see my progress visually), I will develop good habits of writing, and I will procrastinate less because when I read, 'I wrote 500 words today,' I can then set a goal for tomorrow."

Researcher 04:

"If my writing software had any visual analytics on how much I have edited in each writing session, that would make it easier for me to analyze my work, read it, and go back to particular points in time."

Discussion

The present research focuses on examining the administrative challenges that exist within academic activities. Additionally, there is an evaluation of LFAVC. In this connection, the use of manual methods to manage data hinders academic pursuits; but psychological designing of the user interface would enable the process of writing to resume.

Cognitive Load and the Cost of "Version Chaos": These results provide strong evidence in favor of Sweller's (1988), Cognitive Load Theory, which is known as Cognitive Load Theory. Indeed, the extent of "Version Chaos" was evaluated as severe (μ = 3.75). The examples of confusion provided by the interviewed researchers while using such file names as "draft_v1," "final_revised" indicate a significant misallocation of working memory resources. This supports the latest research conducted by Akin and MurrellJones (2018) and Cohen-Adad (2024), which suggests that the improper strategy for the digital management of academic papers triggers researcher burnout. Indeed, current digital writing tools compel researchers to focus on administrative actions while trying to synthesize complex academic arguments. An overwhelming support of "Invisible Versioning" (μ = 4.35) indicates that developers should strive to create software that will make data management tasks invisible in the background of knowledge creation. Contrary to earlier research, which proposed improving manual strategies for folder organization (Criado-Perez et al., 2024; Li & Wilson, 2025), this study shows that eliminating extraneous cognitive load will allow researchers to dedicate 100% of their working memory to knowledge production.

Task-Technology Fit and the Systemic Divides: The results provide stark evidence of a poor Task-Technology Fit (TTF) in current academic tooling. The data revealed two distinct systemic failures that trap researchers in inefficient workflows.

The Skills Divide: While contemporary literature frequently advocates for the adoption of Git-based workflows to enhance academic reproducibility (Hofbauer et al., 2023), empirical data contradict this as a universal solution. Although Git offers absolute data security, it poses a technical barrier that is impossible to surmount for non-STEM scholars (Business μ=4.50; Social Sciences μ=3.77). Essentially, this divide serves to marginalize a huge segment of the academic community, who are forced to use insecure manual approaches.

The Connectivity Divide: Moreover, the fact that 100% of the participants use offline word processors due to internet instability (μ=3.58) reveals a major weakness in the current trend of moving towards a cloud-based architecture.

The high desirability of the "Local-First Architecture" (μ =4.02) proves that researchers require the safety of developer tools without technical complexity, and the automation of the cloud without internet dependency. The LFAVC framework successfully bridges both divides, proving that data sovereignty must be decoupled from technical skill.

"Goal-Setting Theory and "Velocity Analytics": Thesis and dissertation writing is a lengthy process, which is well known for its absence of immediate feedback and often results in a decline in motivation levels. The high level of endorsement given to "Velocity Analytics" (μ=4.17) provides direct evidence in favor of Goal-Setting Theory proposed by Campion and Lord in 1982. The qualitative stories indicated that seeing the amount of work done each day in terms of adding and deleting words made it easy to break down a massive task into daily achievable goals (see Figure 13).

Figure 13: Invisible Versioning and Velocity Analytics



Source: Developed by Researchers, 2026

CONCLUSION

The academic research process is an activity that requires extremely high levels of cognitive engagement in terms of constant focus and attention. Nevertheless, it is the aim of this research to illustrate how scholars are forced to interrupt the cognitive process for engaging in tedious administrative work in terms of manually organizing their data. This multi-perspective research on the topic has demonstrated that the current trend of manually performing file naming tasks, like thesis_final_v2.docx, leads to a phenomenon called "Version Chaos," which unnecessarily increases the cognitive effort required, creating anxiety and disrupting the "Flow State." Furthermore, the problem is accentuated by infrastructure issues, such as the "Skills Divide", making non-technical scholars unable to use developer software, and the "Connectivity Divide", making cloud storage impossible.

This paper explored the feasibility of LFAVC (Local First Automated Version Control). It is a general understanding within academia that the software utilized within software should be similar to "invisible agents". This framework places the responsibility of data security and labor away from humans and onto machines via "Invisible Versioning," hence eliminating unnecessary mental stress. "Velocity Analytics" has been included to enable the use of Goal Setting Theory, hence enabling visual feedback, which will fuel the motivation to conduct long-term research.

It is clear that the future of academic software lies in separating the ownership of the data from its technical complexities. The fact that the program works offline and automatically manages versions gives researchers the freedom to liberate people from the fear of data loss. Ensuring that effective data management is made available to everyone is essential, both from a technical standpoint and from the standpoint of reducing researcher fatigue.

Implications for Future Research Tools in Academia: Too long have we made the academic researcher make a choice between user-friendly word processors, which are unsecured, or powerful developer tools, which are secured yet extremely difficult to learn. The results indicate that powerful version control systems can be entirely transparent, intuitive, and available to all branches of academia. The LFAVC approach is nothing less than a paradigm change in Human-Computer Interaction: future software architectures must break free from the shackles of data management and allow academics to dedicate their full attention to research.

Limitations and Areas for Future Research: Despite the advantages provided by the use of the mixed-methods design, there are certain limitations associated with it, especially the relatively small sample size involving 48 quantitative and 15 qualitative observations according to perceived value. Being a type of concept validation within the Design Science Research paradigm, this study is concerned with the degree of desire associated with the artifact rather than the actual post-implementation performance. The future work will involve developing and testing a prototype of the proposed LFAVC in order to determine its effects on improving productivity, reducing errors, and eliminating anxiety.

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Generative AI & AI-assisted Technologies Declaration: While developing this paper, the researchers employed Google Gemini, which is a pair programming platform, to enhance, improve, and debug Python code for statistical analysis and data visualization through Google Colab. While the researchers used this technology, the author would like to clarify that the author checked all codes and statistical findings before publishing this paper. This paper only presents a theoretical discussion about the LFAV framework.

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