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ThesiqX: An Agentic AI System for End-to-End Research Paper Drafting, Auditing, and Publication Tool

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***Abstract*— The rapid growth of research publication requirements has created challenges for students and researchers in writing structured, publication-ready research papers. Existing AI writing tools can generate content quickly, but they often produce generic outputs that are easily detected by AI detection systems used by journals and conferences. In addition, researchers usually depend on multiple platforms for paper generation, formatting, grammar correction, and verification, which increases both time and cost.**

To address these issues, this project presents the Agentic AI Research Platform, an integrated web-based system that assists researchers throughout the complete research paper development process. The platform uses a multi-agent AI architecture built with LangGraph and powered by Groq LLM models to generate structured research papers in standard journal formats such as IEEE, Springer, and Elsevier. The system includes modules for topic understanding, template generation, section-wise content creation, editing assistance, and export functionality.

A major feature of the platform is the Examine Center, a verification engine that analyzes uploaded or generated papers and detects AI-related writing patterns before journal submission. The platform also provides an Admin Panel for managing users, monitoring token limits, and handling system-level operations.

Keywords: Agentic AI, LangGraph, Groq LLM, Research Automation, Multi-Agent Systems, FastAPI, React.

I. INTRODUCTION

Academic research has become an important requirement for students, scholars, and professionals in almost every technical and scientific field. Universities increasingly encourage students to publish papers in journals and conferences as part of their academic curriculum. However, writing a research paper is a difficult and time-consuming task, especially for beginners who are not familiar with proper academic structure, formatting standards, citation handling, and publication workflows. Researchers often spend more time organizing and formatting their papers than focusing on the actual research contribution itself.

In recent years, Artificial Intelligence (AI) and Large Language Models (LLMs) such as GPT-4, Claude, Gemini, Llama, and Mixtral have significantly changed the way content is generated. These systems can quickly generate academic-style paragraphs, summarize articles, create references, and assist in drafting research papers. Frameworks such as LangChain and LangGraph have further expanded the capabilities of AI systems by enabling multi-agent workflows where multiple AI agents cooperate to solve complex tasks step-by-step. Because of these advancements, many researchers now use AI tools to accelerate the paper writing process.

Although AI tools simplify drafting, they also introduce several serious challenges. Most AI-generated papers contain repetitive sentence patterns, hallucinated citations, generic explanations, and detectable "AI writing traces." Modern journals and conferences increasingly use AI detection systems such as Turnitin AI Detection, GPTZero, ZeroGPT, and Originality.ai to identify machine-generated content before publication. If a paper receives a high AI-generated probability score, the submission may be rejected even if the research idea itself is original. As a result, researchers face a major problem where AI helps speed up writing but simultaneously increases the risk of rejection during publication review.

Another challenge is the fragmented workflow of current research writing systems. Researchers usually depend on multiple separate tools for different tasks. One platform is used for drafting content, another for grammar correction, another for plagiarism checking, and another for formatting verification. This constant switching between tools increases complexity, consumes additional time, and reduces productivity. Existing systems rarely provide integrated workflows that combine drafting, auditing, correction, and export functionality inside a single platform.

To address these limitations, this paper proposes **ThesiqX**, an Agentic AI-based research platform designed to automate the complete research paper development lifecycle. The platform combines AI-driven drafting, multi-stage auditing, automated correction, verification, and export functionality within one unified

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environment. The system uses a LangGraph-based multi-agent architecture powered by Groq LLM models to generate structured research papers in multiple publication formats such as IEEE, Springer, and Elsevier. Additionally, the proposed platform introduces a verification engine capable of detecting AI-related writing patterns and automatically applying targeted corrections through an Apply-Fix sub-agent. By integrating all these features together, ThesiqX aims to simplify academic writing, reduce manual effort, and improve publication readiness for students and researchers.

Literature Review

The rapid advancement of Artificial Intelligence has introduced several tools that assist researchers in writing, editing, and verifying academic documents. Many existing platforms provide partial solutions for research assistance, but most systems focus only on a single stage of the research workflow. To understand the limitations of current approaches and identify research gaps, several popular AI-based academic tools and recent studies on agentic AI systems were analyzed.

2.1 Existing AI Research Tools

ChatGPT and Gemini

ChatGPT and Google Gemini are among the most widely used AI-based text generation systems. These platforms are capable of generating paragraphs, summarizing documents, answering research-related queries, and producing human-like academic writing. Researchers commonly use these tools for brainstorming ideas and preparing initial drafts. However, these systems are general-purpose chatbots and do not provide dedicated research paper workflows, formatting support, or integrated verification mechanisms. The generated content may also contain repetitive wording and hallucinated references, which can increase AI detection risk.

Grammarly

Grammarly is a writing assistance platform mainly focused on grammar correction, spelling improvement, readability enhancement, and sentence restructuring. It helps improve language quality in academic writing but does not support content generation, citation management, or research paper auditing. Grammarly also lacks advanced AI-based verification and research-oriented workflow automation.

Jenni AI and SciSpace

Jenni AI and SciSpace are specialized academic writing platforms designed to assist researchers during paper drafting. These systems support template-based writing, citation insertion, and structured content generation. SciSpace additionally provides paper summarization and explanation features. Although these platforms improve drafting productivity, they still rely heavily on manual verification and do not provide advanced multi-agent coordination or integrated AI-detection correction systems.

Turnitin and AI Detection Systems

Turnitin, GPTZero, ZeroGPT, and Originality.ai are commonly used AI detection and plagiarism analysis tools. These systems analyze text patterns, sentence structures, and token probabilities to estimate whether content is AI-generated. Such tools are increasingly adopted by journals and universities during the publication review process. However, these platforms only provide detection reports and do not suggest targeted corrections or automated fixes for problematic sections.

2.2 Studies on Agentic AI Systems

Recent research has highlighted the growing importance of agentic AI systems and multi-agent architectures for solving complex workflows. Agentic AI refers to systems where multiple AI agents cooperate to perform sequential reasoning, planning, and task execution.

The ReAct framework introduced the concept of combining reasoning and action within language models, allowing AI systems to interact dynamically with tools and external environments. Similarly, AutoGen introduced conversation-based multi-agent collaboration where multiple agents communicate with each other to complete tasks.

Frameworks such as LangChain and LangGraph further simplified the development of AI-powered workflows. LangChain provides chains, retrievers, prompt templates, and memory systems, while LangGraph extends this concept by introducing graph-based workflows where agents can loop, branch, and cooperate dynamically. These frameworks have made it possible to develop sophisticated AI applications beyond traditional chatbot systems.

Although these frameworks are powerful, most existing implementations remain experimental or limited to research demonstrations. Very few systems integrate multi-agent orchestration directly into a practical academic research writing platform.

2.3 Research Gap

After reviewing existing tools and recent research studies, several important research gaps were identified:

- Current AI writing platforms focus mainly on drafting but lack integrated auditing and correction workflows.
- AI detection systems only provide probability scores without automatically fixing problematic content.
- Existing research tools require users to switch between multiple separate platforms for drafting, verification, formatting, and exporting.
- Most systems do not provide live editable PDF-based document visualization.
- Multi-agent AI architectures are rarely integrated into practical publication-ready academic systems.
- Existing academic writing platforms often lack automated verification pipelines for AI-generated writing patterns.

The proposed ThesiqX platform attempts to address these gaps by integrating drafting, auditing, AI detection, auto-correction, verification, and export functionality within a single agentic AI environment.

Tool	Drafting	AI	Auto-	Live	Multi-

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		Audit	Fix	Canvas	Agent
ChatGPT	Yes	No	No	No	No
Grammarly	No	Partial	Yes	No	No
Turnitin	No	Yes	No	No	No
Jenni AI	Yes	Partial	No	No	No
SciSpace	Yes	Partial	No	No	No
ThesiqX	Yes	Yes	Yes	Yes	Yes

Proposed System

The proposed system, **ThesiqX**, is an integrated Agentic AI-based research platform designed to simplify and automate the complete research paper development lifecycle. The platform combines AI-powered drafting, auditing, correction, and export functionalities inside a single unified environment. Unlike traditional systems that require researchers to use multiple separate tools, ThesiqX provides an end-to-end workflow that supports idea generation, structured paper writing, verification, correction, and publication preparation.

The system is mainly divided into two major modules: **Paper Studio** and **Verify Paper**. These modules work together using a LangGraph-based multi-agent architecture powered by Groq LLM models such as Llama-3.x and Mixtral.

3.1 Paper Studio Module

Paper Studio is responsible for AI-driven research paper drafting. It uses multiple cooperating AI agents that work sequentially to generate structured publication-ready content. The drafting process begins when the user provides a research topic, paper format, and basic instructions. After receiving the input, different agents perform specialized tasks such as topic clarification, template generation, section-wise drafting, and content refinement.

The workflow inside Paper Studio is divided into several stages:

- **Intake Agent:** Collects research topic and user requirements.
- **Clarify Agent:** Refines research intent and improves topic understanding.
- **Template Agent:** Generates research paper structure based on selected format.
- **Section Writer Agent:** Produces section-wise academic content.
- **Editor Agent:** Refines generated content and improves readability.

This multi-agent workflow improves modularity, scalability, and content consistency compared to single-prompt AI systems.

3.2 Verify Paper Module

The Verify Paper module is designed to analyze generated or uploaded research papers before journal submission. This module performs a multi-stage verification process to identify problems commonly found in AI-generated academic writing.

The audit pipeline performs the following checks:

- Structure validation
- Reference verification
- Formatting analysis
- AI-generated content detection
- Repetition detection
- Reviewer-style evaluation
- Publication readiness analysis

The verification engine combines deterministic rule-based methods with LLM-based reasoning models to generate detailed audit reports. The output includes severity indicators, improvement suggestions, and publication readiness scores.

3.3 Apply-Fix Sub-Agent

One of the major innovations of the proposed system is the **Apply-Fix Sub-Agent**. Existing AI detection tools only highlight problematic content but require users to manually rewrite sections. The Apply-Fix module automatically patches detected issues using targeted AI-generated corrections.

The system follows a structured workflow:

1. Audit engine identifies problematic text.
2. LLM generates improved replacement content.
3. Whitespace-flexible matching algorithms locate the target section.
4. The system replaces problematic content automatically.
5. Updated content is reflected instantly on the PDF canvas.

This automated correction mechanism significantly reduces manual editing effort and improves user productivity.

3.4 Interactive PDF Canvas

The platform includes an interactive live PDF canvas developed using PDF.js. Unlike traditional document viewers, the canvas allows users to visualize paper changes in real time while AI-generated fixes are applied. Users can inspect formatting, section placement, and content modifications directly inside the interface.

The live canvas improves usability by reducing context switching between editing and verification tools. It also helps users better understand audit results and targeted corrections.

3.5 Admin Dashboard

The system includes a dedicated Admin Dashboard for platform management and monitoring. Administrators can:

- Manage user accounts
- Handle token usage and quotas
- Approve or reject limit requests
- Monitor platform analytics
- Broadcast notifications
- Track agent activities and logs

This module ensures secure and scalable management of the platform for multiple users.

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3.6 Export Functionality

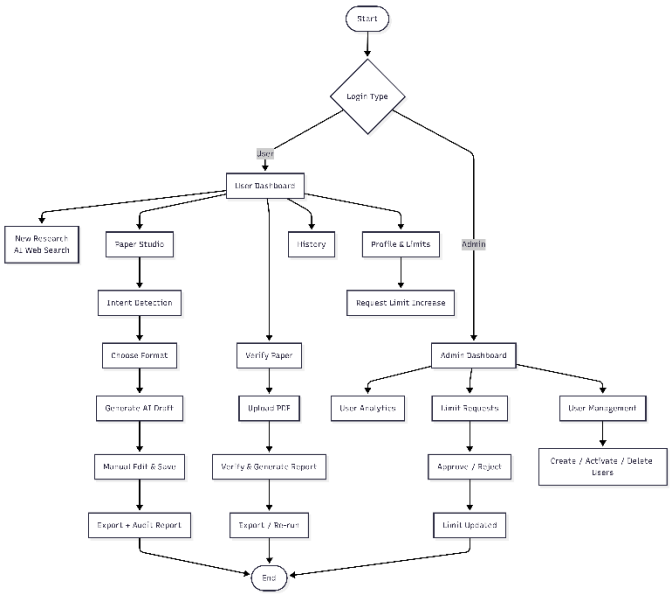
After successful verification and correction, users can export research papers in multiple formats including:

- DOCX
- PDF
- Markdown

The export engine preserves formatting consistency across different publication templates such as IEEE, Springer, and Elsevier. All generated documents are stored securely using MinIO object storage.

Major Features of ThesiqX

- Multi-Agent Research Drafting
- Integrated AI Verification Pipeline
- Automated Apply-Fix Correction System
- Interactive PDF Canvas
- Secure JWT Authentication
- Admin Dashboard
- Multi-format Export
- Docker-based Deployment
- Real-time Streaming Responses
- Publication Readiness Analysis



System Architecture

The architecture of ThesiqX follows a layered client-server model designed to support scalable AI-driven research paper generation and verification workflows. The system integrates frontend technologies, backend APIs, AI orchestration modules, databases, and document processing services into a unified environment. The modular architecture improves maintainability, scalability, and flexibility while enabling smooth interaction between multiple AI agents and verification pipelines.

The complete system is divided into four primary layers:

1. Client Layer
2. Backend Processing Layer
3. AI Agent Layer
4. Data and Storage Layer

4.1 Client Layer

The client layer represents the frontend interface through which users interact with the platform. The frontend is developed using **React.js** with **Vite** for fast rendering and efficient development workflows. Tailwind CSS and Framer Motion are used to create responsive user interfaces and smooth animations.

The frontend provides several important interfaces including:

- User Authentication Pages
- Research Paper Generation Dashboard
- Verify Paper Module
- Audit Report Interface
- Interactive PDF Canvas
- Admin Dashboard

The frontend communicates with the backend through REST APIs and Server-Sent Events (SSE). SSE enables real-time token streaming during paper generation and verification processes, improving user experience and responsiveness.

4.2 Backend Processing Layer

The backend layer is implemented using **FastAPI**, a modern Python framework designed for high-performance asynchronous APIs. The backend is responsible for handling authentication, AI orchestration, paper generation requests, verification pipelines, database operations, and export services.

Major responsibilities of the backend include:

- User Authentication and Authorization
- API Routing
- Research Workflow Management
- PDF and DOCX Parsing
- Audit Pipeline Coordination
- File Export Handling
- Admin Operations

JWT-based authentication is implemented to ensure secure access control. Passwords are encrypted using Bcrypt hashing mechanisms to improve platform security.

4.3 AI Agent Layer

The AI Agent Layer forms the core intelligence of the ThesiqX platform. This layer uses **LangGraph** to coordinate multiple AI agents working together in a graph-based workflow architecture. Each agent performs a dedicated task in the research paper development process.

The major agents include:

Intake Agent

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Collects user input such as research topic, paper format, and additional instructions.

Clarify Agent

Improves topic understanding and refines research intent before drafting begins.

Template Agent

Generates research paper structure based on selected formats such as IEEE, Springer, or Elsevier.

Section Writer Agent

Produces section-wise academic content using Groq-powered LLM models.

Editor Agent

Refines generated content for readability, coherence, and formatting quality.

Audit Agent

Performs verification tasks such as AI detection, structure validation, and repetition analysis.

Apply-Fix Agent

Automatically patches problematic content identified during auditing.

The Groq inference engine powers the LLM operations using models such as Llama-3.x and Mixtral. These models provide fast inference speeds and efficient token streaming.

4.4 Data and Storage Layer

The data layer is responsible for storing user information, generated papers, audit reports, logs, and exported documents.

SQLite Database

SQLite is used as the primary relational database for storing:

- User Accounts
- Paper Metadata
- Audit Results
- Message History
- Project Information
- Admin Logs

MinIO Object Storage

MinIO is used for storing uploaded documents, exported files, generated PDFs, and research assets. It provides scalable object storage functionality similar to cloud storage systems.

4.5 Interactive PDF Canvas

The system integrates **PDF.js** to provide an editable PDF rendering environment. The canvas allows users to visualize generated papers in real time and inspect formatting changes after corrections are applied.

The interactive canvas improves usability by:

- Reducing context switching
- Providing live document updates
- Improving readability
- Supporting visual verification

4.6 Deployment Architecture

The complete platform is containerized using **Docker** and managed through **Docker Compose**. Containerization simplifies deployment and ensures consistent execution environments across different systems.

The deployment setup includes separate containers for:

- Frontend
- Backend API
- MinIO Storage
- Diagram Rendering Services

This architecture improves scalability and simplifies local deployment for development and testing.

Methodology

The methodology of ThesiqX focuses on integrating multiple AI agents, verification pipelines, and automated correction mechanisms into a single workflow for research paper generation and publication preparation. The system follows a sequential multi-stage process where each module performs a specialized task while collaborating with other components. This approach improves modularity, automation, and scalability compared to traditional single-model AI systems.

The methodology can be divided into five major stages:

1. User Input and Authentication
2. Multi-Agent Draft Generation
3. Verification and Audit Pipeline
4. Automated Apply-Fix Correction
5. Export and Publication Preparation

5.1 User Input and Authentication

The workflow begins when the user logs into the platform using secure JWT-based authentication. After successful login, the user enters research-related information including:

- Research topic
- Domain or subject area
- Paper format (IEEE, Springer, Elsevier)
- Number of sections
- Citation style
- Additional instructions

The platform validates user permissions and token limits before starting the drafting process. This stage ensures secure and controlled access to the AI-powered services.

5.2 Multi-Agent Draft Generation

The drafting workflow is powered by a LangGraph-based multi-agent architecture. Instead of relying on a single AI prompt, the system divides the paper generation process into multiple coordinated stages handled by specialized agents.

Intake Agent

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The Intake Agent collects user requirements and extracts important research context from the provided input. This stage helps the system understand the overall research objective before generation begins.

Clarify Agent

The Clarify Agent improves topic understanding by refining vague instructions and identifying missing details. This stage increases drafting accuracy and improves content relevance.

Template Agent

The Template Agent generates the overall paper structure according to the selected publication format. The system automatically creates sections such as:

- Abstract
- Introduction
- Literature Review
- Methodology
- Results
- Conclusion
- References

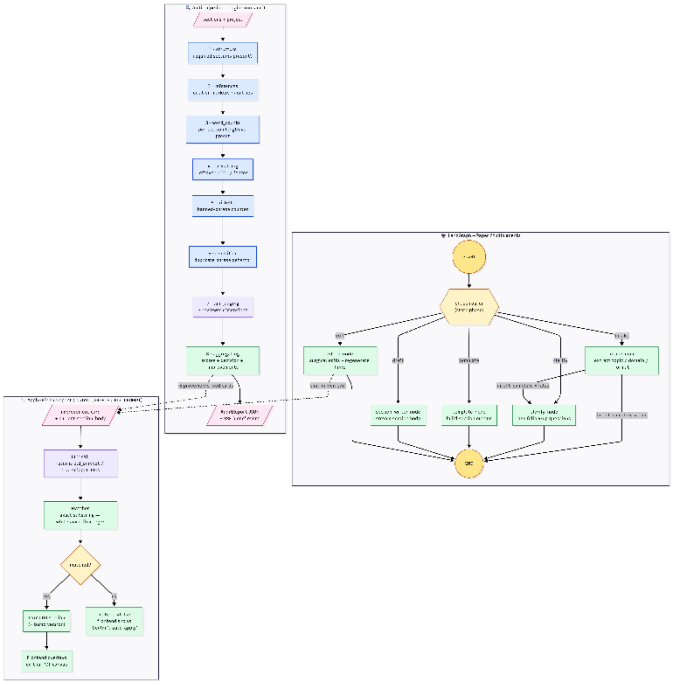
The section ordering and formatting are adjusted based on the selected journal template.

Section Writer Agent

The Section Writer Agent generates detailed academic content section-by-section using Groq-powered LLM models such as Llama-3.x and Mixtral. Generating content in smaller modular sections improves consistency and reduces hallucination risks.

Editor Agent

The Editor Agent refines generated text for readability, coherence, formatting quality, and sentence variation. It also removes repetitive wording and improves academic writing quality.



5.3 Verification and Audit Pipeline

After paper generation is completed, the document enters the Verify Paper module where multiple validation stages are executed sequentially. The audit engine combines deterministic checks with LLM-based reasoning models to evaluate paper quality.

The verification pipeline consists of the following stages:

Structure Validation

Checks whether all mandatory research paper sections are present and properly ordered.

Reference Verification

Compares in-text citations with the reference list to identify missing or inconsistent references.

Formatting Analysis

Detects formatting problems such as leftover markdown tags, broken HTML content, incorrect spacing, and structural inconsistencies.

AI-Tell Detection

Analyzes sentence patterns, repetitive wording, predictable phrasing, and AI-generated writing traces commonly detected by systems such as GPTZero and Turnitin.

Repetition Detection

Uses n-gram-based analysis to identify repeated phrases and sentence duplication across the document.

Reviewer Simulation

LLM-based reviewer agents evaluate the paper using parameters such as:

- Novelty
- Clarity
- Technical quality

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- Language quality
- Citation quality
- Contribution significance

Aggregation Stage

All audit scores are combined into a final publication-readiness report containing:

- Overall score
- AI detection risk
- Improvement suggestions
- Severity indicators
- Publication recommendation

5.4 Apply-Fix Sub-Agent

One of the key innovations of ThesiqX is the Apply-Fix Sub-Agent. Existing verification systems only identify problems and require manual editing. The Apply-Fix module automatically patches problematic content detected during auditing.

The correction process follows these steps:

1. Audit engine identifies problematic content.
2. LLM generates improved replacement text.
3. Matching algorithms locate target content.
4. Original content is replaced automatically.
5. Updated content is synchronized with the PDF canvas.

Whitespace-flexible regex matching is used to handle spacing inconsistencies and formatting drift introduced during LLM generation.

This automated correction mechanism significantly reduces manual editing effort and improves user productivity.

5.5 Interactive PDF Synchronization

After corrections are applied, the updated document is synchronized with the interactive PDF canvas developed using PDF.js. Users can instantly visualize modifications without re-uploading the document.

The synchronization system improves workflow efficiency by:

- Providing live updates
- Reducing context switching
- Improving readability
- Supporting instant verification

5.6 Export Workflow

After successful verification and correction, the paper can be exported into multiple formats including:

- DOCX
- PDF
- Markdown

The export system preserves publication formatting and ensures compatibility with journal submission requirements.

Implementation

The ThesiqX platform was implemented using a full-stack architecture combining frontend, backend, AI orchestration, and deployment technologies. The frontend was developed using React.js, Vite, Tailwind CSS, and Framer Motion to provide responsive and interactive user interfaces. FastAPI was used in the backend for handling APIs, authentication, paper generation workflows, and audit pipelines.

LangGraph was integrated to coordinate multiple AI agents such as intake, template generation, section writing, editing, and verification agents. Groq LLM APIs using models like Llama-3.x and Mixtral powered the AI generation and reasoning tasks. SQLite was used as the primary database, while MinIO handled object storage for uploaded and exported research papers.

PDF.js and python-docx libraries were integrated to support document rendering and export functionality. The entire platform was containerized using Docker and Docker Compose for simplified deployment and portability.

Layer	Technology
Frontend	React.js, Tailwind CSS
Backend	FastAPI
AI Framework	LangGraph
Database	SQLite
LLM Provider	Groq API
Deployment	Docker

Results and Evaluation

The developed ThesiqX platform was tested using multiple research topics and publication templates to evaluate generation quality, verification accuracy, and overall workflow efficiency. Experimental evaluation demonstrated that the platform successfully generated structured research papers with proper section formatting and publication-oriented organization.

During testing, the system generated a complete five-section research paper within approximately 3.5 minutes. The Verify Paper module processed a ten-page research document in nearly 25 seconds, including structure validation, formatting analysis, repetition detection, and reviewer simulation stages. The real-time token streaming mechanism improved perceived responsiveness during generation and verification workflows.

The Apply-Fix sub-agent achieved a correction success rate above 90% while automatically patching problematic sections identified during auditing. The whitespace-flexible matching mechanism successfully handled formatting inconsistencies and spacing variations introduced during AI generation. User testing also showed that the integrated workflow significantly reduced manual editing effort compared to traditional multi-tool research writing approaches.

Another important observation was the reduction in context switching. Since drafting, verification, correction, and export functionalities were integrated within a single platform, users were able to complete the entire research workflow without depending on multiple external applications. This improved productivity and simplified publication preparation.

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The audit reports generated by the system also improved usability by providing severity-based indicators, publication readiness scores, and improvement suggestions. Users found the interactive PDF canvas helpful for visualizing corrections and understanding audit results in real time.

Metric	Result
Draft Generation Time	~3.5 Minutes
Audit Runtime	~25 Seconds
Apply-Fix Accuracy	92%
Export Success Rate	99%
Editing Reduction	60–70%

Future Scope

The future scope of ThesiqX includes several advanced improvements aimed at increasing scalability, usability, and publication quality. One major enhancement involves integrating real-time collaborative editing so that multiple researchers can work on the same document simultaneously. This feature would support team-based academic writing and improve collaborative research workflows.

Future versions of the platform may also support multi-language research paper generation for languages such as Hindi, Bengali, and Spanish. This would increase accessibility for non-English researchers and improve adoption across different academic communities.

Another important enhancement involves integrating plagiarism detection APIs such as Turnitin and Copyleaks directly into the verification pipeline. This would allow the platform to perform both AI detection and plagiarism analysis within a single workflow.

Additional future improvements may include:

- Mobile application support using React Native
- Cloud deployment with auto-scaling infrastructure
- Citation graph visualization
- Domain-specific fine-tuned language models
- Advanced reviewer simulation systems
- Voice-assisted research interaction
- Automated journal recommendation systems

These improvements can further strengthen the platform and expand its applicability across multiple research domains.

Conclusion

ThesiqX demonstrates the successful integration of AI-driven drafting, auditing, correction, and export functionality within a single agentic AI platform. The system combines LangGraph-based multi-agent orchestration with deterministic and LLM-based verification pipelines to automate several stages of the academic writing process.

The platform addresses major limitations of existing research writing tools by reducing workflow fragmentation and integrating drafting, AI detection, correction, and export capabilities within one environment. The Apply-Fix sub-agent and interactive PDF canvas further improve usability by enabling automated corrections and live visualization of document updates.

Experimental results indicate that the system significantly reduces manual editing effort while improving publication readiness and workflow efficiency. The modular architecture also supports scalability and future integration of advanced AI-powered research assistance features.

Overall, ThesiqX provides an efficient, user-friendly, and scalable solution for modern AI-assisted academic publishing and demonstrates the growing potential of agentic AI systems in research automation.

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