# AI POWERD PAPERS EVALUEATION

## Abstract:

Academic assessment, particularly grading computer-typed assignments, consumes significant time and resources in educational environments. This paper proposes an AI-powered software system that automates evaluation of PDF-based student assignments using a fine-tuned BERT model. The system compares submissions with a provided answer key or, if absent, generates ideal answers autonomously, delivers annotated PDF feedback highlighting errors, and concludes with accurate solutions. An integrated notes platform enhances learning for both students and teachers by identifying essential content. This approach aims to address the increasing workload of teachers, expand scalability in educational assessment, and ensure consistent, rapid feedback.

## Introduction

The increasing scale of modern educational environments has brought renewed attention to the challenge of efficiently evaluating student work. As class sizes expand and instruction shifts across in-person, hybrid, and fully online formats, the demand for timely and consistent assessment has grown substantially. Although digital submission platforms have simplified the management of assignments, the core task of grading—particularly for open-ended, computer-typed responses—remains heavily dependent on human evaluators. This reliance not only intensifies the workload for instructors but also introduces variability in feedback quality and delays in returning results to students.

Recent developments in natural language processing, especially the advancement of large language models such as BERT, offer promising opportunities to address these limitations. These models demonstrate an improved ability to interpret, analyze, and score complex textual inputs, making them suitable for academic assessment tasks that traditionally resist automation. Their capability to understand contextual meaning, identify key concepts, and recognize patterns in student writing provides a foundation for more reliable and scalable evaluation methods.

This research proposes an AI-assisted assessment system that applies modern language models to automatically grade assignments, generate detailed feedback, and produce concise learning summaries. The aim is to reduce the manual burden on educators while maintaining, and potentially enhancing, the fairness, accuracy, and instructional value of academic evaluations. By integrating AI into the assessment process, the study explores a path toward more efficient educational workflows and a strengthened support system for both teachers and learners.

## Problem Description

Manual evaluation of assignments, even in digital form, is time-consuming, error-prone, and inconsistent across educators. Teachers frequently confront repetitive grading, leading to delays in student feedback and diminished attention on instructional activities. Existing digital solutions are limited by the need for explicit answer keys and lack of sophisticated language understanding. Furthermore, there is little support for extracting critical notes and learning points for both students and teachers from assignment material. There is an acute need for a system capable of handling computer-typed assignment PDFs, evaluating their content with or without answer keys, highlighting mistakes, and delivering corrected, detailed feedback, while also synthesizing key notes for enhanced learning outcomes.

## Related Work

Numerous recent works have explored automated assignment grading, plagiarism detection, and intelligent tutoring using AI models. Below, we summarize 25+ key research contributions from the past five years. For each, we describe the research idea, primary approach/model, and highlight how the proposed BERT-powered system advances beyond prior work:

[1] Work on automated essay scoring using deep learning has typically relied on architectures such as LSTMs and CNNs to predict holistic scores for essays based on lexical and semantic features. These systems mainly output a numeric grade or band level and generally do not return detailed, question-wise feedback or error annotations on the student document. In contrast, the proposed system not only evaluates answers but also generates an annotated PDF that highlights specific mistakes and provides correct answers at the end, offering richer pedagogical value.

Document-level transformer models such as DocBERT demonstrate that contextualized representations improve grading for long-form responses and complete documents. These approaches process entire essays or assignments to predict overall scores or rubric-aligned labels; however, they usually stop at score prediction and do not modify or annotate the original document. The proposed system extends this idea by using a fine-tuned BERT model to drive both grading and detailed in-document highlighting of errors, making the feedback directly visible in the original PDF.

Transformer-based plagiarism detection approaches focus on measuring semantic similarity between student submissions and existing documents to identify copied content. While effective for academic integrity checking, such systems do not evaluate correctness with respect to learning objectives and do not generate corrected answers. The proposed work can be integrated with plagiarism detection but primarily targets concept understanding and correctness, providing corrective feedback rather than only similarity scores.

Neural network-based automated grading systems have explored multi-layer perceptrons and other deep networks for predicting grades on assignments. These models often require large, labeled datasets tailored to specific courses or question sets, limiting generalization across subjects. By leveraging a pre-trained BERT model with fine-tuning, the proposed system benefits from transfer learning, reducing data requirements and enabling more flexible application while adding detailed feedback and corrections.

Question-answering-based automated assessment methods using BERT compare student answers directly to reference answers or model outputs to determine correctness. Such systems usually assume the availability of a high-quality answer key and focus on scoring at the response level. The proposed system builds on this concept but introduces a fallback mode where, in the absence of an answer key, the model generates ideal answers itself and compares student responses against those, expanding usability when keys are not prepared.

AI-based academic feedback generators provide generic comments on grammar, coherence, and style, often using large language models to suggest improvements. These tools are helpful for writing support but are not tightly aligned with the marking scheme or specific question requirements. The proposed system differs by aligning evaluation with question-level correctness and learning objectives and by embedding feedback directly into the PDF with highlighted mistakes and correct answers per question.

NLP-based formative assessment systems for open-ended questions aim to provide feedback on short textual responses, typically focusing on conceptual correctness within one or a few sentences. Although useful for quizzes or small tasks, they do not scale well to multi-page assignments and do not produce a fully annotated document. The proposed system is designed specifically for complete, typed PDF assignments, providing end-to-end processing from upload to annotated output.

Research on assignment grading using RoBERTa and similar transformer variants demonstrates improved accuracy over traditional models in predicting grades. However, these efforts usually limit themselves to numerical or categorical scoring without generating corrected solutions or explanatory feedback. By contrast, the proposed approach uses BERT not only for scoring but also for constructing corrected answers and embedding them as a summary section in the graded PDF.

Deep-learning-based assignment marking with hierarchical attention networks focuses on capturing document structure and salient parts of student responses. While attention mechanisms help identify important sentences, most such systems still output only a grade or high-level feedback. The proposed system uses the model’s understanding of salient content to mark exact error spans in the PDF and provide targeted corrections, thus more directly supporting learning.

Systems like SmartGrader apply machine learning to exam evaluation, scoring answers automatically and sometimes providing brief comments. These tools often operate within custom web interfaces and may not integrate well with PDF workflows or support rich annotation. The proposed system centers on PDF as the input and output medium, producing a teacher- and student-friendly annotated PDF that fits naturally into existing digital assignment practices.

Approaches that combine BERT with CRF layers for short-answer scoring focus on precise matching of key phrases and entities to a reference answer. They perform well when clear, concise keys exist but are less effective for long, descriptive responses. The proposed solution generalizes to both short and long answers and can operate with AI-generated reference responses when human keys are missing, making it more adaptable in real classroom scenarios.

Automated grading of computer science assignments often emphasizes code correctness, using test-case execution, static analysis, or models tailored to program text. These methods are highly domain-specific and do not generalize to theoretical or essay-type answers. In contrast, the proposed system targets natural-language, computer-typed content across disciplines, enabling automated evaluation for theory, explanation, and descriptive questions as well.

Teacher-assistance platforms such as NLP-driven feedback tools aim to support educators by suggesting comments and pointing out potential issues. Despite being helpful, they usually function as semi-automatic aids, with the teacher still performing most of the evaluation and editing. The proposed system is designed for largely autonomous operation, minimizing teacher workload by automatically grading, annotating mistakes, and generating a corrected-answer section.

Intelligent tutoring systems based on transformers focus on hint generation, step-by-step guidance, and formative feedback during learning activities. Their main goal is tutoring, not summative evaluation of completed assignments. The proposed system can complement such tutors by providing final, comprehensive assessment of submitted work, including detailed error highlighting and corrected answers, thereby bridging tutoring and evaluation.

Rubric-based essay assessment with NLP maps essay content to rubric dimensions such as organization, style, or argument strength, often yielding multi-dimensional scores. Although powerful for writing assessment, these systems are not optimized for question-by-question academic tasks where specific factual answers are required. The proposed system is explicitly question-oriented and produces both scores and correct answers, making it more suitable for structured assignments and exams.

End-to-end student assessment with BERT frameworks show that transformer models can learn complex evaluation criteria and directly predict performance metrics.

Nonetheless, they rarely modify or annotate the original student submission and often treat the document as a black-box input for scoring. In contrast, the proposed system outputs a transformed version of the assignment—a marked-up PDF—giving transparent, interpretable feedback for each error.

LLM-based assessment platforms that use large language models for evaluation often provide high-level summaries and comments about student work. These systems may not be tightly aligned with PDF-based workflows or may not consistently generate per-question corrected answers. The proposed system explicitly structures output by question, integrates with PDF, and ensures that each error is linked with a clear, model-generated correction.

Active-learning-based grading methods reduce labeling costs by selecting informative examples for teacher annotation, iteratively improving the grading model. While efficient in model training, these techniques still depend on repeated teacher involvement in labeling. The proposed system can be fine-tuned initially but is designed to operate with minimal ongoing teacher labeling, particularly due to the ability to use AI-generated reference answers.

Feedback-oriented student paper-marking approaches prioritize detailed comments on organization, clarity, and style, providing rich qualitative feedback. However, they often neglect strict correctness with respect to a marking scheme or answer key and do not generate a final corrected solution set. The proposed work integrates both detailed feedback and explicit correct answers, enhancing both writing quality and conceptual accuracy.

Vision-based assignment marking for handwritten PDFs leverages OCR and computer vision models to recognize and grade handwritten content. These systems face challenges with recognition errors, varying handwriting, and noisy scans. By focusing purely on computer-typed assignments, the proposed system avoids these issues and can more reliably extract and analyze text for grading and annotation.

Automated summarization of student notes uses NLP techniques to condense content into key points, aiding revision and review. Such systems support learning but do not perform evaluation or grading of assignments. The proposed system incorporates a similar summarization capability as a dedicated notes module for both students and teachers, while also providing full grading and correction of assignments in one integrated platform.

Document-level semantic grading with models like XLNet has shown that capturing long-range dependencies improves grading performance on extended texts. Despite this, most such work remains limited to predictive scoring and does not provide direct, actionable corrections. The proposed BERT-based approach adopts document-level understanding but extends it to error localization and corrected-answer generation within the PDF output.

Grading automation for massive open online courses emphasizes scalability, using machine learning to assign scores to thousands of submissions efficiently. These systems prioritize throughput and often provide minimal feedback beyond a score due to scale constraints. The proposed system, while scalable, is designed to maintain rich, per-question feedback and corrected answers even in large cohorts, improving learning effectiveness.

NLP support tools for teachers in assignment review commonly highlight linguistic features or suggest possible comments to streamline manual grading. They remain assistive rather than fully automatic and may not integrate tightly with course-specific marking schemes. The proposed system aims to take over the bulk of grading work, needing teacher involvement mainly for configuration and occasional review, thereby substantially reducing workload.

Siamese-network-based semantic answer comparison methods compute similarity between student answers and model answers to support automatic scoring, particularly for short, fact-based questions. Their dependence on predefined keys and focus on short responses limit their use for comprehensive, multi-question assignments. The proposed system generalizes this idea with a transformer backbone that can handle long answers and, crucially, can generate reference answers automatically when keys are unavailable, enabling broader practical deployment.

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## Methodology

The system architecture involves the following steps:

1. **PDF Ingestion**: Accept computer-typed assignment PDFs submitted by students.
2. **Text Extraction**: Extract structured text content for analysis.
3. **Answer Key Handling**: If an answer key is uploaded, use semantic similarity (BERT model) for answer comparison. If not present, system generates ideal answers using a fine-tuned BERT response model.
4. **Grading and Annotation**: Evaluate responses per question; automatically highlight errors and discrepancies in the PDF, referencing specific mistakes and overall grade.
5. **Correction Output**: Insert correct answers and feedback at the end of the annotated PDF. Students receive both clear error indicators and suggested solutions.
6. **Notes Extraction Module**: Allow both teachers and students to upload notes. The AI model identifies the most important learning points using attention weights and presents summarized notes with markers for critical content.
7. **Model Training**: BERT is further fine-tuned on a domain-specific education dataset, augmented with labeled assignment responses, answer keys, and teacher feedback.
8. **User Dashboard and Upload Portal**: Separate portals for teachers and students to manage submissions, notes, and feedback, ensuring privacy and security.

The methodology emphasizes transparency, adaptability (with or without answer keys), and comprehensive feedback directly embedded in assignment PDFs, supporting both grading and educational improvement.

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