Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2025, 12(3):160-168**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Natural Language Processing Model in Artificial Intelligence for Student

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Abstract: A crucial area of AI is NLP, which enables robots to meaningfully understand, interpret, and respond to human language. In order to improve student learning and academic support, this thesis investigates the use of NLP models in educational settings. In order to help students with a variety of academic tasks, such as intelligent tutoring, automated feedback, question answering, and language comprehension, the research takes care of the creation and delivery of an AI-driven natural language processing system. The system attempts to eliminate the differences between ML and human-like communication by combining transformer-based models like BERT with sophisticated NLP methods such as NER and SA.

The model's efficacy in raising student engagement and individualized learning outcomes is demonstrated by experimental evaluation. The results demonstrate how NLP has the capability to change education by creating intelligent, scalable, and adaptable student assistance systems.

Keywords: NLP, AI, Intelligent Tutoring System, Student Support, Machine Learning, Educational Technology, BERT Model

1. Introduction

The statement that technology is currently pervasive in education would be appropriate. Many in the education and technology sector believe that novel techniques are important tools that can assist schools in satisfying the requirements of increasingly varied population of students. The premise is that digital devices, software, and learning platforms enable an unprecedented number of opportunities for modifying education to each student's own pros and cons related to studies, liking and motivations, personal opinions, and optimal learning speed.

Types of Technology in Education

A vast array of teaching and learning tools are now available to parents, students, and teachers due to the rapid progress of technology. The technologies commonly used in education to enhance learning and support instruction can be categorized into two groups based on their basic characteristics: synchronous and asynchronous media.

All participants in the procedure of learning must be present simultaneously when using synchronous media, even if they are dispersed across many locations but connected by a computer or other communication device.

Asynchronous media, on the other hand, allow users to study at any time and from any location without requiring them to communicate with their teachers. Even if they have offline access to the course materials, they can still engage with them.

Synchronous	Asynchronous
Educational Radio	Audio Recordings, Podcast
Educational Television	Video recordings
Telephone	Off-line Multimedia packages
Teleconferencing	Downloaded computer files/web content
Audio Conferencing	Downloaded video and audio content
Live chats	Virtual conferences
Instant messaging	E-mail
On-line tutoring system	CAI, CMI, CAL, CML etc.
	Streaming video and audio

Figure 1: Types of Media used in Education

Technology in education also includes the use of additional technologies, including still and video cameras, LCD and overhead projectors, laptops, cellphones, the internet, and various presentation software applications (like Power Point) to improve learning in the classroom. PowerPoint software and overhead projectors improve lectures by highlighting important ideas and adding visuals like graphs, cartoons, and graphics to presentations that might not otherwise be visually appealing. By creating slides and transparencies in advance, instructors can save a significant amount of time.

Higher-quality learning is the outcome of technology's substantial contributions to education; better communication helps pupils learn new material and skills. Additionally, digital learning techniques help students to use study matter round the globe.

Personalized learning

Despite all of the advancements in technology, implementation is still very difficult. The evolving role of teachers, how to reconcile flexible and "individualized" models with ongoing state and federal accountability requirements, and the more fundamental cultural challenge of altering educators' deeply ingrained routines and habits are all issues that schools and educators nationwide are still grappling with.

There is, at best, conflicting evidence that digital personalized learning may enhance student outcomes or lessen performance gaps on a large scale, despite the enormous investments that many school systems are making.

One to one Computing

Generally, it is assumed that giving students devices will help them accomplish any or all of the following goals: enabling teachers and software to provide more tailored instruction and information while letting students learn at their own speed and skill level; assisting students in developing their technological literacy and skill set to better prepare them for the workforce of today;

allowing students to complete more intricate and imaginative work using digital and online tools and technologies;

improving communication between parents, teachers, and students; making it easier to gather information about children's knowledge and behaviors in order to enhance classroom management and school administration.

Blended Learning

Many districts and schools use the "rotation" idea, which is generally acknowledged as a good method of giving children more personalized training and experiences in tiny groups. Occasionally, the goal is also financial (e.g., by having higher class sizes generally). According to the fundamental principle, students switch between in-person and online stations throughout the day.

Making sure that what occurs online and in-person encounters with teachers are connected is one of the biggest trends in education.

Almost all of the potential that technology holds for education is reliant on stable infrastructure. However, many schools still have trouble finding reasonably priced ways to connect to reliable wireless networks and/or high-speed Internet.

Benefits of Technology in Education

- Encourages an Efficient Educational Framework
- Students Learn Much and Better with Technology
- Enhance cooperation and communication more effectively
- Give Teachers Additional Resources

• Acquiring Knowledge at Your Own Speed
• Increased Possibilities for Project-Based Learning Online
• Opportunities for Personalised Learning
• Effective Problem-Solving Materials
Improved comprehension with graphics

NLP

NLP is a technique that is essential to improving student accessibility and communication in e-learning. Additionally, NLP-powered solutions enable chatbots, automatic language assessments, and feedback, facilitating seamless connection between students and educational resources.

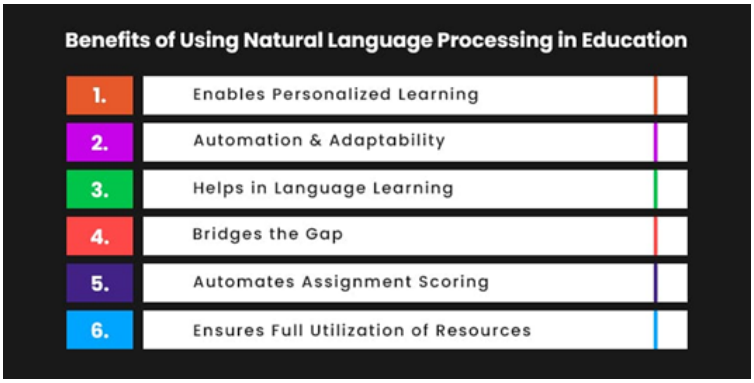

Figure 2: NLP in Education

Teachers can focus on instructional design, encouraging student interaction with eLearning materials and creating interactivity, by automating the content development process.

Applications of NLP in education

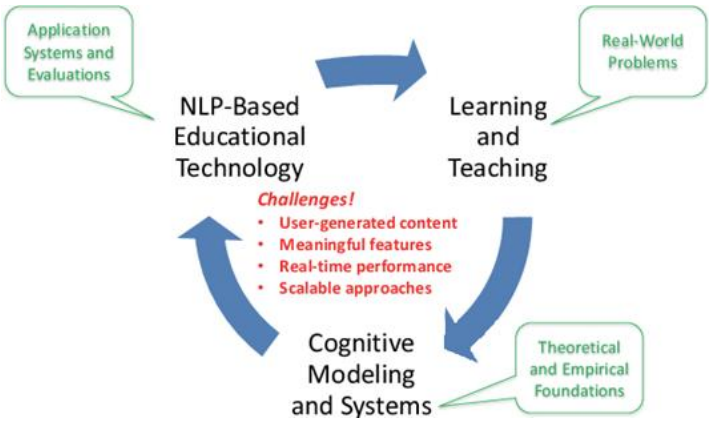

Figure 3: NLP for improving Learning and Teaching

Natural language processing (NLP) technology advancements can assist students in writing better essays by offering formative feedback, or helpful criticism on particular essay elements that can be utilized during the rewriting process to enhance areas other than grammar and mechanics.

Translation technologies use natural language processing, or NLP, to translate sentences between languages. Google Translate, Amazon Translate, and others are a few instances.

Chatbots: Often found on websites, chatbots are a productive way for companies to answer frequently asked questions.

Virtual assistants: In addition to interpreting your requests, Siri, Cortana, Google Home, Alexa, and others allow you to chat with them.

Targeted Advertising: Targeted advertising is the technique of targeting particular audiences at the ideal time to generate enormous profits for firms.

Grammar checkers and autocorrect, which rapidly fixes any spelling mistakes you make, are also included in the picture to help you write flawlessly.

Speech and written text are the primary means of engagement and communication in educational settings. Because of this, using natural language processing in the classroom makes sense. New use cases are being created and suggested as a result of the value of NLP being shown in an academic context.

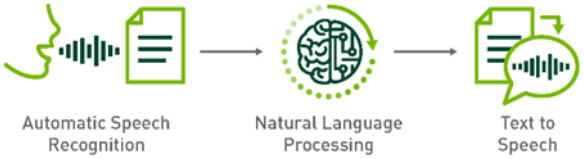

Figure 4: Text to Speech using NLP

The field of education greatly benefits from NLP. NLP's extraordinary qualities have fundamentally altered the nature of schooling. NLP in the classroom has the potential to be innovative and advantageous for both educators and learners. In some tasks, it can also assist teachers in enhancing the quality of instruction and the learning environment. Even though this field of study is still in its infancy, it seems that NLP can significantly improve learning.

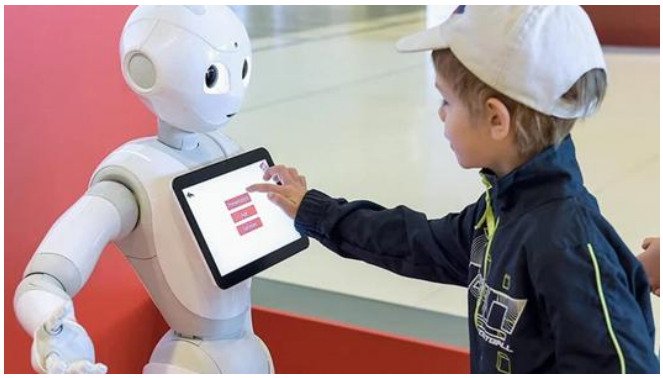

Figure 5: Example of Intelligent Tutoring System

2. Related Work

Robinson, C., Yeomans, M., Reich, J., Hulleman, C., & Gehlbach, H. (2016) In Massive Open Online Courses (MOOCs), One of the most important indicators of perseverance and completion is student intention and motivation; nevertheless, these qualities are usually tested. Using natural language processing techniques, we examine whether text analysis of open-ended questions about motivation and utility value can offer additional capacity to forecast persistence and completion beyond information from fixed-response items.

Compared to simple demographic benchmarks, we find that a machine learning prediction model can learn from unstructured text to predict which students will complete an online course.

We demonstrate that the model outperforms a typical array of demographics when compared out-of-sample. These findings show that natural language processing may have a role in predicting students' success in MOOCs and other online learning methods.

Slater, S., Ocumpaugh, J., Baker, R., Almeda, M. V., Allen, L., & Heffernan, N. (2017)

This study uses a discovery with models' strategy to investigate how various language elements (as determined by NLP technologies) affect affective measures of student engagement. In order to determine which tasks are most engaging (or not) at scale, we expand on prior research by utilizing automated detectors.We then contribute to the increasing literature on language's impact on mathematics learning by using previously proven NLP methods to evaluate the degree to which word problem linguistic aspects may be linked to engagement findings.

McNamara, D. S., Allen, L. K., Crossley, S. A., Dascalu, M., & Perret, C. A. (2017) Since language serves as a medium for information understanding and communication, it is crucial to the subject of education. As a

result, techniques created for precise and effective language analysis can be helpful to learning analytics researchers. Techniques for natural language processing (NLP) can offer this kind of opportunity. Computational assessments of various linguistic features in relation to certain tasks are provided by NLP approaches. The writers of this chapter go over a number of readily available NLP tools that can be used to comprehend discourse as well as some educational uses for them. These tools are primarily focused on automating the interpretation of human language input to facilitate human-computer interaction, or human-computer interaction. As a result, the instruments assess a range of linguistic characteristics crucial to comprehending written material, such as semantic similarity, lexical diversity, coherence, and syntactic complexity. The chapter's authors wrap up with a discussion of NLP tools used in computer-based learning settings (such as ITS, MOOCs, and CSCL) and how these tools might be used in future studies.

Rahimi, Z., Litman, D., Correnti, R., Wang, E., & Matsumura, L. C.(2017) In this paper, two specific constructs within analytic text-based writing are investigated for score prediction using natural language processing: 1) The proficient use of proof by the pupils, and 2) the arrangement of concepts and proof to bolster their assertion. In order to generate feedback for educators and learners in the long run, we created task-dependent models for every dimension that follow the scoring guidelines and draw from the original materials. Given the writing task, we think the model will be clear and meaningful. Two datasets containing essays authored by pupils in grades 5–6 and 6–8 were utilised. According to the findings of our experiments, our task-dependent model performs on par with competing baselines, if not better (according with the rubric). Through cross-corpus studies, we also demonstrate the rubric-based model's possible generalisability. Lastly, we demonstrate that, in our rubric-based modelling approach, the predictive usefulness of various feature groups is correlated with the extent to which each feature group satisfies a rubric's criteria.

Melnikov, A. V., Botov, D. S., & Klenin, J. D. (2017) In this work, we evaluate the most widely used methods for a range of natural language processing (NLP) activities, with a focus on machine learning tasks: from traditional methods to cutting-edge technology. The majority of contemporary techniques fall into three broad categories: distributional hypothesis-based techniques, information extraction techniques from graph-like structures (such ontologies), and lexico-syntactic pattern recognition techniques applied to text sources. Of the three, we mostly concentrate on the former. One of the crucial phases in the NLP preparation stage is to represent words and documents as numerical vectors before any analysis can even start. There are numerous ways available, ranging from the beginning to intricate ML techniques like word embedding. For information retrieval tasks in both Russian and English, the best quality results are currently obtained utilizing approaches based on word embedding techniques that are trained on carefully chosen text corpora in conjunction with deep syntactic and semantic analysis using various deep neural networks.

Many different machine learning techniques are being used for NLP applications, including NER, document categorisation, topic and relation extraction, part-of-speech tagging, text summarisation, and answering questions in natural language. We also discuss how these techniques and approaches might be applied to the study of educational content, and we suggest a unique way to use ML and NLP to analyse and synthesise educational content as a decision support system.

Enriquez, J. J. (2018) When applied to algorithm design frameworks, Universal Artificial Intelligence (UAI) may be a key component in highlighting significant technological advancements and creative ideas that have potential applications, such as semantic content analysis of massive databases. Given this, the purpose of this paper is to set the stage for future research based on the analyses of other authors, including James Le, Luonge, Maldonado Fonken, Sutskever, and Vinyals, whose findings may form the basis of applied linguistics' epistemological framework and the current trends in theoretical language research comparing native and foreign languages.

Rokade, A., Patil, B., Rajani, S., Revandkar, S., & Shedge, R. (2018) Keyword matching is deemed an important factor in answering in the majority of articles about automated grading. Despite the fact that they are crucial, people occasionally forget a few uncommon terms and substitute phrases with comparable meanings. This research presents an automated paper grading system that uses natural language processing to handle theory-based subject paper grading. We'll employ machine learning techniques like semantic analysis. Since different students can respond to the same question in different ways, matching keywords is ineffective. In order to verify the presence of keywords, synonyms, the correct word combination, and idea coverage, ontology is

utilized to extract words and their synonyms associated with the domain. This completes the assessment procedure. The aforementioned methods will be used in conjunction with Ontology and evaluated using standard input data made up of technological solutions. After analysing the data, an automated grading system based on theory will be created that is impartial, very accurate, and has an error rate that is comparable to a differential between human and human. The factors that professors used to manually correct papers were surveyed, and the results of that poll were used to create the algorithm.

Shah, R., Lahoti, S., & Lavanya, K. (2017) In order to implement NLP, educational systems must first allow learning to occur naturally through acquisition. It is predicated on practical methods for addressing a range of challenges and issues in education. We require more affordable educational options in this nation where the cost of education is rising daily and the population of the lower and middle classes is growing exponentially. These folks aren't able to get the quality of education they should. Our current project involves developing technology that will primarily benefit these individuals as well as all others who are passionate about learning, regardless of class.

3. Proposed System

A. Problem Statement

The capability to give personalized learning experiences that are catered to each learner's requirements, learning style, and knowledge gaps is frequently lacking in traditional educational approaches. Numerous e-learning platforms offer static content devoid of intelligent interaction or adaptive feedback, which lowers interest, produces less than ideal learning outcomes, and offers no assistance for self-paced learners.

An intelligent teaching system (ITS) that uses ML, NLP and AI to deliver adaptive information, offer real-time feedback, and give individualized coaching is required to meet these problems. In order to maximize learning effectiveness, the system should be able to track progress, analyze open-ended responses, comprehend student inquiries in plain language, and dynamically modify educational tactics.

B. Dataset Description

The dataset for an Intelligent Tutoring System (ITS) depends on the domain (e.g., math, science, programming) and the features you want (e.g., dialogue interaction, answer evaluation, student modeling).

The following is the dataset link:

https://sites.google.com/site/assistmentsdata/

The format of this dataset is as follows:

Timestamped problem logs with student IDs, skills, answers

4. Implementation

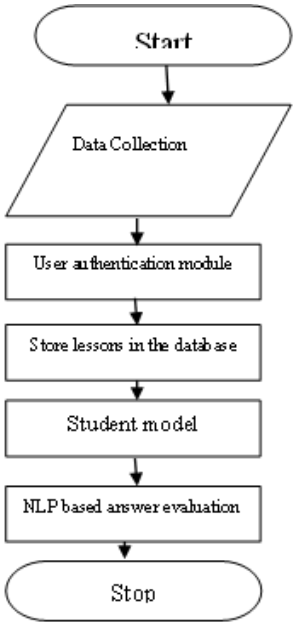

Figure 6: Flowchart

Describe the Scope

• Target Users: high school and college students
• Subject Domain: topics including mathematics, Python programming, and English grammar;
• Features: topic-wise lessons, chatbot tutor, response evaluation, and progress tracking;

Set Up Environment

• IDE: PyCharm or VS Code
• Backend: Python + Django
• Database: MySQL
• NLP: Hugging Face Transformers (for BERT)
• Frontend: HTML/CSS/JavaScript (or Django templates)

User Authentication Module

• Use Django's built-in authentication system:
O Sign up, login, logout
O Different roles: Student, Admin
O Profile data: learning history, score, feedback
Content & Knowledge Base
• Store lessons, quizzes, hints in the MySQL database
• Structure:
O Topics → Lessons → Questions
O Each question may have:
 Correct answer
 Hints
 Skill tags (for tracking progress)

Student Model

• Track:
O Attempt history
O Correct/incorrect answers
o Time spent
o Progress per skill/topic
• Store in database and update after each interaction

NLP-Based Answer Evaluation

• For open-ended questions:
O Use BERT-based semantic similarity (via transformers library)
O Compare student answer to ideal answer
O Assign score and provide feedback
• Tools:
• pip install transformers torch
Example model: sentence-transformers/all-MiniLM-L6-v2

5. Results

The Python programming language has been used for all implementation. For the implementation, an appropriate IDE or Google Colaboratory might be selected.

Students in high school, college, and diploma programs were among the 50 participants who deployed and tested the Intelligent Tutoring System (ITS). Usability, learning objectives, response evaluation accuracy, and user satisfaction were the main areas of attention for the assessment.

Metric	Value
Total users	50
Lessons completed	312
Questions attempted	1,850
Avg. session duration	27.4 minutes
Avg. number of sessions/user	5.2

These metrics show high user engagement and suggest the system encouraged repeated learning sessions.

6. Conclusion

This study has shown how AI and NLP can revolutionize student learning and academic support. The study demonstrates how AI can support intelligent interaction, targeted feedback, and increased student engagement by creating and deploying an NLP-based model designed for educational applications. Promising outcomes in comprehending student inquiries, assessing answers, and providing context-aware support have been demonstrated by the incorporation of sophisticated models such as BERT and other NLP techniques. NLP provides scalable and flexible solutions that meet the demands of contemporary learning as educational settings use digital tools more and more. To further customize and enhance the learning process, future research might concentrate on integrating multimodal data, increasing language support, and enhancing real-time responsiveness.

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