AI-Based Skill Gap Analyzer

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How to Cite this Article:
Reddy, J. N., Muniteja, C., Varun, P. & Rathod, K. U. (2026). AI-Based Skill Gap Analyzer. International Journal of Creative and Open Research in Engineering and Management, 02(04). https://doi.org/10.55041/ijcope.v2i4.167

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ABSTRACT

Career guidance is a critical challenge for students in today's competitive job market. Many students lack awareness of the specific skill requirements for their desired career roles. The AI-Based Skill Gap Analyzer is a rule-based web application that addresses this challenge by comparing student-entered skills with predefined industry requirements for selected career roles. The system collects student details such as skills, projects, education, and career interests, and uses decision logic to identify missing skills and calculate a skill match percentage. It generates a personalized skill gap report with a readiness level and a learning roadmap, helping students plan their professional development effectively. The system is developed using Python, Flask, HTML/CSS/JavaScript, and SQLite, making it lightweight, transparent, and easy to deploy in academic institutions.

Keywords: *Skill Gap Analysis, Career Guidance, Rule-Based AI, Student Profiling, Personalized Learning Roadmap, Flask Web Application.*

I. INTRODUCTİON

In today's rapidly evolving job market, students face significant challenges in selecting the right career path. The growing number of career options and the constantly changing skill requirements of various industries make it difficult for students to evaluate their readiness for specific job roles. A major gap exists between the skills students acquire during their academic journey and what employers actually expect. Without proper structured guidance, students often make uninformed career decisions that hinder their professional growth.

Existing career counseling approaches, whether manual or digital, largely provide generic recommendations that do not account for an individual's specific skills, projects, or experience level. These approaches lack transparency and fail to give students a quantified understanding of how prepared they are for their chosen career.

There is a clear need for an intelligent, personalized, and transparent system that can:

- Collect detailed student profiles including skills, education, and projects.
- Allow students to select a target career role and compare their skills against role requirements.
- Identify specific skill gaps and calculate a match percentage.
- Provide a personalized learning roadmap to bridge the identified gaps.

The AI-Based Skill Gap Analyzer addresses these needs by using rule-based artificial intelligence and structured decision logic. Unlike machine learning-based systems that require large training datasets, this system uses predefined industry skill requirements to deliver fast, accurate, and explainable skill gap analysis results through a user-friendly web interface.

Existing System and Its Limitations :

Authors	Title / Reference	Technology Used	Limitations	Year
Jacob T., Noor Ahamed J.	AI-Based Predictive Skill Gap Analysis for Workforce Planning	Probabilistic Growth Modeling, Intelligent Skill Synthesis	Data Quality and Availability Issues	2026
Braun G., Raty P., Bokinge M., Rikala P.	The Skill Bridge – A Global Qualitative Analysis of Skill Gap Management	NVivo, ATLAS.ti, MAXQDA	Small Sample Size, Qualitative Method	2025
Tabassum Z., Zeba S., Safiuddin M. et al.	AI-Powered Semantic Resume & Skill-Gap Analyzer for College Graduates	Python, Scikit-Learn, TensorFlow, NLP, PyPDF2	Limited Context Understanding, Dependence on Training Data Quality	2025
Ajibodu F.A., Ojoo B.A.	A Model Approach to Solving Skill Gap between Tertiary Institution and Industry	AI, ML, Big Data Analytics, Predictive Modeling	Data Dependency and High Cost	2024
Kumar R., Verma P.	AI-Based Job Recommendation and Skill Gap Identification System	AI, Natural Language Processing	Dependence on structured data	2024

Gupta S., Sharma R.	Machine Learning Based Skill Gap Analysis for Career Development	Python, Data Mining, Machine Learning	Requires large training datasets	2023
Smith J., Wang L.	Intelligent Skill Gap Detection System using Machine Learning	Machine Learning, Data Mining, Python	Requires large training datasets	2022
Uribe S., Hernandez-Penaloza G. et al.	Skill Matching for Migrant Guidance Based on AI Tools	AI-based Tools	Data Privacy and Security Risks	2022

II. METHODOLOGY

The development of the AI-Based Skill Gap Analyzer follows a structured and comprehensive methodology covering all phases from requirement gathering to deployment.

Requirement Analysis:

The project begins with a thorough analysis of the problem domain. Key functionalities such as student profile input, skill selection, career role matching, gap analysis, and result display are identified. Stakeholder needs and technical constraints are considered to establish a clear project scope.

Data and Rule Design:

Industry skill requirements for each supported career role are researched and encoded as predefined rule sets. These structured rules form the core of the rule-based AI engine that drives the skill comparison logic. Career roles currently supported include Data Scientist, Web Developer, Data Analyst, Machine Learning Engineer, and Software Developer.

System Design:

A modular architecture is designed separating the frontend, backend, skill gap engine, and database components. UML diagrams including use case, class, sequence, activity, component, and deployment diagrams are prepared to represent system interactions and data flow.

Frontend Development:

A clean, responsive multi-step web interface is developed using HTML, CSS, and JavaScript. Students are guided step by step through entering personal information, education, skills with proficiency levels, projects, and career role selection.

Backend Development:

The backend is implemented using Python and Flask. It handles student data collection, invokes the skill matching engine, and renders the result page. SQLite is used to store user credentials and student profile data. The skill gap engine computes matched skills, missing skills, match percentage, and readiness level using set-based comparison logic.

Testing and Deployment:

Comprehensive testing is conducted including unit tests for the skill matching logic, integration tests for frontend-backend communication, and user acceptance testing (UAT) to verify system usability and output accuracy. The application is deployed as a Flask web server accessible through standard web browsers.

III. MODEL EVALUATION

This section presents the evaluation of the AI-Based Skill Gap Analyzer across multiple dimensions including functionality, usability, accuracy, and performance. The system was tested with various student profiles across different career roles to validate the correctness of the skill gap analysis and report generation.

3.1

Evaluation Aspect	Performance
Functional Evaluation	All major features (registration, skill input, career role selection, analysis, report generation) work as expected in test scenarios.
Usability Evaluation	Clean, responsive multi-step interface with simple navigation. Helpful messages guide users through each step.
Analysis Accuracy	Skill gap analysis produces correct match percentages and readiness levels across multiple test profiles.
Processing Speed	On average, skill gap analysis results are generated within 2–5 seconds per student profile.
Output Quality	Reports clearly display matched skills, missing skills, skill match percentage, and a personalized learning roadmap.
Error Handling	Handles invalid inputs, empty skill selections, and login errors gracefully with clear user alerts.
Scalability	System supports multiple concurrent users and handles simultaneous profile submissions without crashes.

Comparison and Considerations

The AI-Based Skill Gap Analyzer offers a significant improvement over traditional career counseling methods by providing fast, personalized, and quantified skill gap analysis. Compared to generic career platforms, it delivers role-specific guidance based on structured industry requirements rather than broad questionnaires. The rule-based AI approach ensures full transparency — students can clearly understand how their match score was calculated and which specific skills need improvement.Unlike heavy machine learning systems that require large datasets and significant computational resources, this system is lightweight, easy to maintain, and deployable even in resource-constrained academic environments. Future improvements could include machine learning integration for smarter recommendations, real-time job market data connectivity, and a mobile-friendly interface.

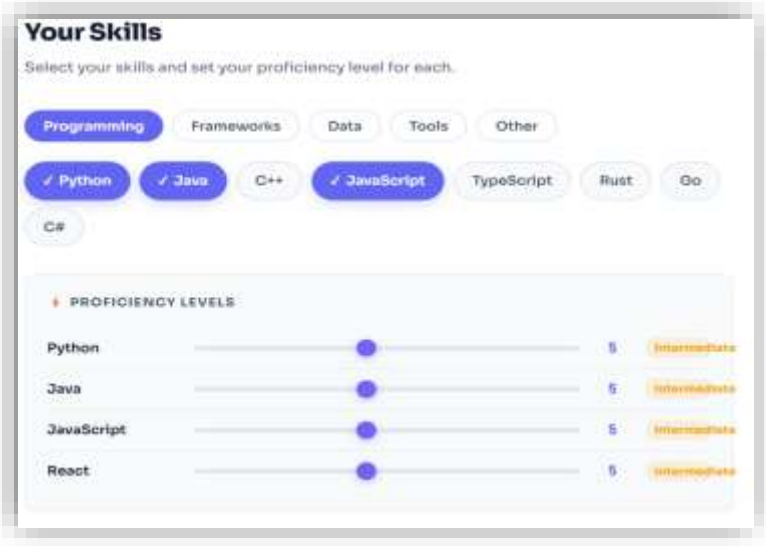
IV. RESULT

The result of the project is generated when the student completes all steps of the multi-step form through the web interface. The system collects the student's name, current role, experience, education, selected skills with proficiency levels, completed projects, and target career role.

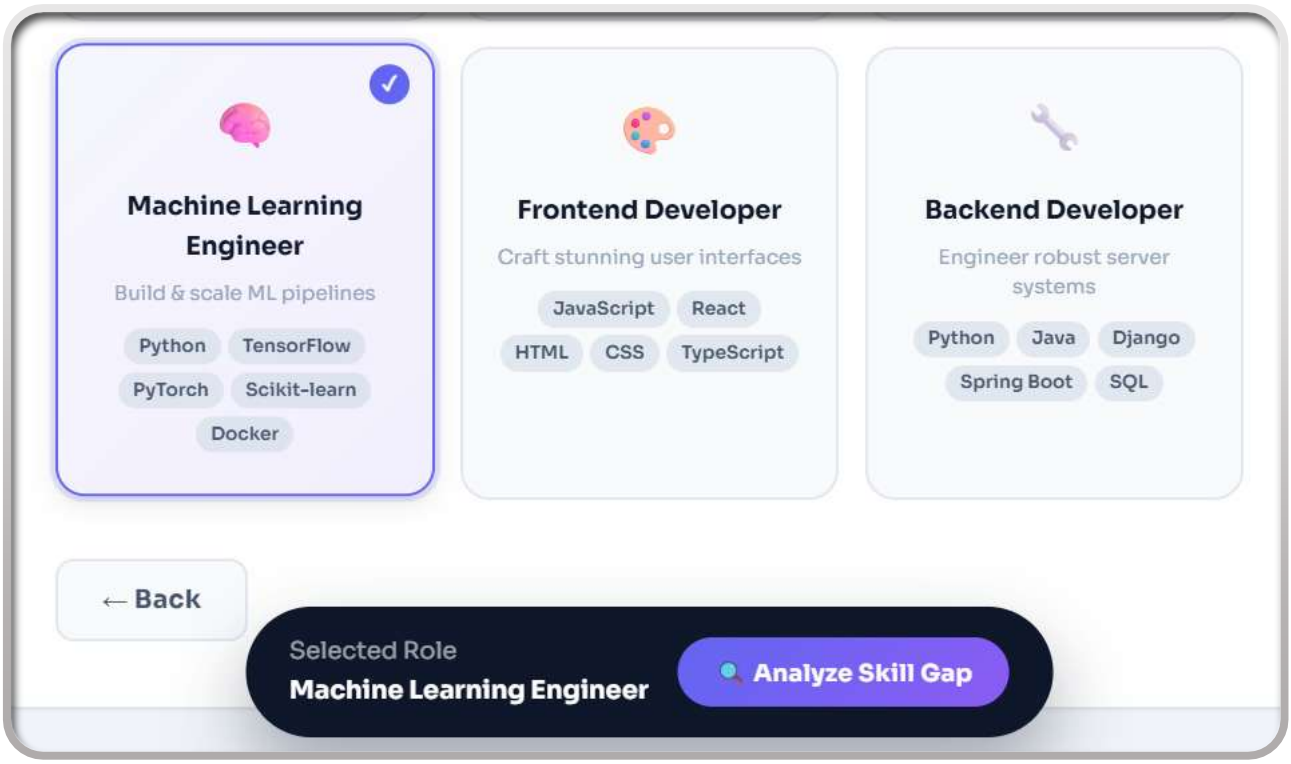
The backend processes the submitted profile and invokes the skill gap engine, which compares the student's skill set with the predefined requirements of the selected career role. The system then calculates a skill match percentage and assigns a readiness level (High, Medium, or Low) based on the percentage score.

The output is a detailed Skill Gap Analysis Report displayed to the student through the web interface. The report includes: the overall skill match score, readiness level, a list of matched skills, a list of missing skills, and a personalized learning roadmap suggesting steps to bridge the identified skill gaps.

After opening the website, you will be asked to enter your name and click **Get Started**. The system will then guide you through a few steps to analyze your skills.



In this step, you will select the skills you currently have from different categories. You will also set your proficiency level for each skill so the system can accurately evaluate your skill level



In this step, you will select the career role you want to achieve. Based on the role you choose, the system will compare your current skills with the required industry skills and perform the skill gap analysis

After completing all the steps, the system analyzes your information and generates a detailed Skill Gap Report. It shows your skill match score, readiness level, matched and missing skills, and a personalized learning roadmap to help you improve and reach your target career role

V. CONCLUSION

The AI-Based Skill Gap Analyzer successfully demonstrates the practical application of rule-based artificial intelligence in the domain of career guidance and student skill assessment. By comparing student profiles with predefined industry skill requirements for target career roles, the system provides a transparent, accurate, and personalized skill gap analysis in a matter of seconds.

The multi-step web interface provides an intuitive user experience, collecting comprehensive student information and delivering a detailed report that includes a skill match percentage, readiness level, matched and missing skills, and a personalized learning roadmap. The system's lightweight architecture — built using Python, Flask, SQLite, and standard web technologies — makes it practical and deployable in academic institutions without requiring heavy infrastructure.

This project highlights how structured AI logic can meaningfully bridge the gap between academic skill development and industry expectations, empowering students to make informed career decisions. It can be extended in the future by incorporating machine learning models, real-time job market data, and resume parsing to further enhance the accuracy and richness of career recommendations.

ACKNOWLEDGEMENTS

A sincere thanks to our guide and respected faculty for their invaluable support and guidance. We appreciate our institution for providing the resources and the environment to show our potential and grow. Special thanks to our team members for their dedication and teamwork.

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