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Student Skill Market Imbalance Analyzer

A Machine Learning-Based Framework for Bridging the Engineering Talent Gap

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***Abstract*— It's becoming harder to match engineering students skills that match with what tech companies actually need. This work gives the Student Skill Market Imbalance Analyzer (SSMIA), a data-driven and analytical framework designed to analyze the gap between student skill-sets and industry demand. The proposed system has utilized two primary datasets: student skill profiles and job market requirements, it is used to collect from platforms such as LinkedIn and Indeed. Identify core skills in web series job postings by applying standard NLP techniques, using how often they appear to represent current hiring trends. demand, benchmarks and availability. This score is basically a shortcut to see how different these groups are from each other .In addition, an Employ-ability Score is derived to evaluate the correspondence of individual student skill sets with hiring trends and professional standards. A slim model is used to embed the rank in the students skills and data according to their readiness for the job market analysis. The results are Evaluated through the side-by-side evaluation and visualization techniques and analytics. Experimental analysis indicates that the emerging domains such as machine learning(ML), cloud computing, and DevOps have substantial imbalances, while there is a clear oversupply in certain foundational skills in the market. The framework delivers data-driven recommendations for the students, academic institutions, and training platforms to bridge the skill gap and boost professional readiness. It helps students learn exactly what the industry is looking for making it easier and impact**

***Keywords*—Skill gap analysis, machine learning, Devops, Bridge the skill gap, Natural language processing(NPL), Data-driven, student skill profiles, benchmarks, employ-ability score**

I. INTRODUCTION

Technology is moving so fast that today's workers need and require totally different skills. Technologies are growing so fast with things like cloud computing, edge computing and AI, that the curriculum often falls behind. It's leading to a real disconnect between what students are being taught and skills companies that are actually needed. We call this an engineering skills gap , and it impacts everyone from students to the entire economy.

Recent data shows that more than 60% of employers are facing difficulty finding candidates who are right fit for a job. According to data from NASSCOM (National Association of Software and Services Companies)reports that just 43% of Indian engineering graduates are job-ready for technical roles out of college. Right now, current methods of identifying and addressing the skills gap are slow and manual. Curriculars are usually only updated for every few years, based on limited feedback from alumni or a few industry partners. These methods are not flexible enough to keep up with rapidly changing industry needs, nor do they provide the tailored guidance. In response to these challenges, we present the **Student Skill Market Imbalance Analyzer (SSMIA)**, a data-driven framework to measure the gap between current academic training and the actual requirements of the professional world. The system integrates student data and market insights through Machine Learning, delivering easy-to-understand analytics on current skill gaps. The goal of this framework is to bridge the skills gap by guiding the students and providing academic advisors with the actionable data. It helps what companies actually need right now.

This study makes the following key contributions:

- This system used to collect the students' real skill data by analyzing a multiple group of 450 engineering students by giving their review and it has been used to consider across the various.
- To analyze the industry needs by collecting a job descriptions and processing using the Natural Language Processing Natural Language Processing
- A supervised ML has been used in this case where the approach was used to predict the student employability, real time skills with a A simple MLP neural network proved by the most accurate in predicting the job readiness and baseline models have been used.

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II. Background And Related Studies

Recent research in data mining and Machine Learning (ML) has increasingly focused on the job and labor market. Our work builds on this by analyzing the disconnect between students' learning and industry needs, using the data to find the ways to improve a student's career outcomes.

A. Academic performance Analysis by data mining

Machine learning techniques are frequently used in the Educational Data Mining to study the student data and skill sets. These methods help researchers identify the key patterns in how students learn, performance and engagement within the academic environment. Most current research focuses on academic success rather than career readiness. While these models are great at predicting grades or dropout risks, they mostly ignore the gap between skills and actual industry needs. They fail to address the skill mismatch after graduation. Current research is too focused on grades, the need for systems that move beyond.

B. Labor Market Analytics platforms

More and More , researchers are using job postings to keep tabs on which skills are in demand. These approaches analyze market data to identify the high - demand insights .Previous studies show that automation is changing in the job market and emphasize that workers need to keep learning. While the research is great, it does not provide a hands - on tool that actually works in the real world, but in the tech world , there is no easy way to measure if a student is ready for these new industry requirements.

C. Hybrid Skill Gap Analysis and the support

Research that combines both the student skill data and industry requirements is still limited in the real world. Some existing approaches attempt to match student profiles with job requirements and their matching skills using simple keyword-based methods so it becomes easy for them to analyze. However, these methods often lack accuracy because they do not capture the actual meaning or importance of skills, where the data is never given accurately. Pattern-based recommendations help, but they are not enough to measure the real time students skill data, its puts a number on a gap between what students know and what industry wants.

Study	Approach	Dataset	Limitation
Acemoglu & Restrepo [3]	Economic model	Labor stats	No student-level analysis
LinkedIn Economic Graph [6]	Graph analytics	Platform data	Proprietary, not reproducible
SSMIA (Proposed)	ML + NLP + Survey	Hybrid	Regional scope (expanding)

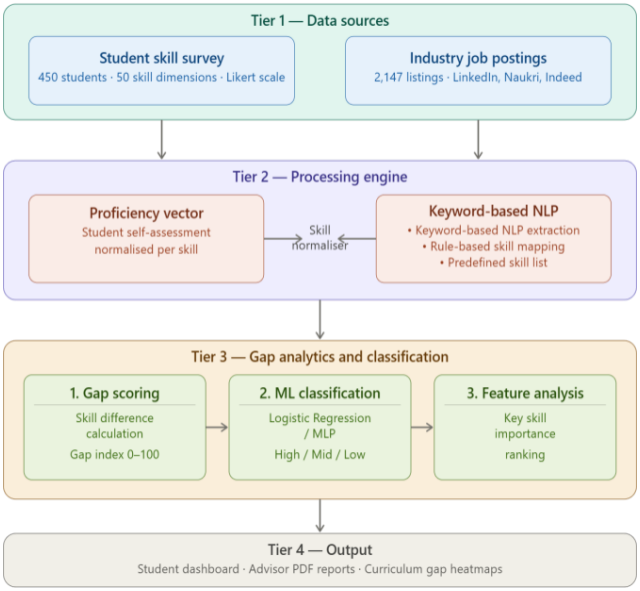
III. SSMIA - System Architecture And Design

A. Architectural Overview

The proposed Student Skill Market Imbalance Analyzer (SSMIA) is used to follow a modular three- tier architecture. The system Is organized into some main layers Data Ingestion and Preprocessing Layer, Analytics and Machine Learning Layer, and Visualization and Reporting Layer

By this they used to classify and study even in the monitoring system the same technique has been used. By following these tires where the model has been established to use the correct supervised ML. That used to figure in the SSMIA system architecture overview.

Fig. 1. SSMIA system architecture overview



Based on this Tier 1 - Data sources it was the first and basic thing in the Architecture by that where its used to collect the data from the both student and job side so that it was easy to review the real time data. So, the first step is collecting the data, but Tier 2 - is the brain of the system, it runs a processing engine for four students' self assessments and on the other side the job bench markers are used to demand their skilled insights.

In Tier 3 - it focus on predicting , analyzing basically using the ML by that where we get the scoring and the calculation used to predict

Lastly Tier 4 - after completing the 3 tiers it is used to get dashboards and advanced text reports through the PDF itself.

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B. Data preparation and Preprocessing

The Student Skill Market Imbalance Analyzer (SSMIA) prepares the Layer bridges in the gap between the raw student data input and the industry demands and benchmarks . We use the structured survey approach to college students' skill by measuring the scale on 1 to 5 accuracy, on the industrial side the major job boards like Internshala , LinkdIn and Indeed.

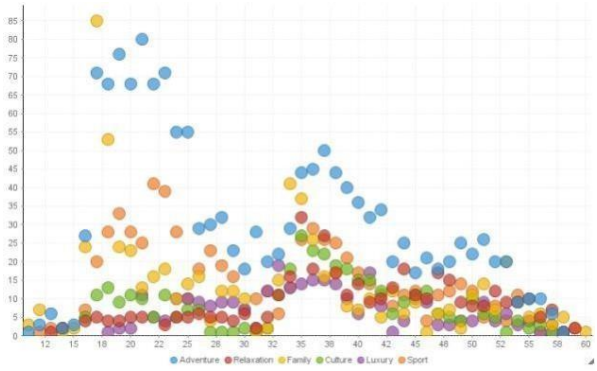
To maintain this data integrity, we need to apply automated text processing to normalize the skill names. This system accurately measures the skill gap between the students' skills and job demands. Although cloud computing is consumed on a pay-as-young basis, improper use of resources can create spikes in billing that are palpable. Organizations must continuously track resource usage with a view to optimizing workloads, so as not to incur unnecessary costs. The tools for cost analysis and budgeting are essential for efficient cloud spending.

C. Visualization and Reporting Interface

The system features a React.js dashboards that clearly displays the results. It's got the radar charts so that the Students can see how they measure up the jobs and also the heat-maps that point out where groups are falling behind. This system also suggests specific ways to upskills based on where the students are falling short. The system used to identify exactly where a student might be falling behind and suggest ways to upskill.

Finally, areas such as real-time data processing, edge computing, and hybrid cloud environments can benefit from more research contributions to enhance system performance as well. We're also using automation to stay proactive, catching and stopping threats before they can do any real damage.

So that visually reporting is very important in this case by that where they no need to struggle , even the simple things by presenting like this it would be easy for decision making, saving time , flexibility those things and the users can able to understand easily.



IV. Survey Methodology And Findings

This process survey methodology was used to find how and where the study skill fails when it comes to job demand. By finding and measuring the thing is to say survey by finding those areas and giving more focus on that where the area will build a strong foundation.

A. Survey Design and Participant Demographics

Building on a pilot study and faculty validation, this research evaluates the workforce readiness of the graduate engineering students, mostly for CS, IT and Electronics majors. It's the same story every graduation season. Students are essentially coming out of college just to get good grades. To find the problem behind this, what are skills that students have that's not a job provided by that , students study based on scope that should help them and get a job for the survey is mainly focused on students skills required.

By using the SSMIA upcoming university first year students were used to calculate and select a course based on that that also makes a good option for them instead choosing a random course and struggling behind because in the future suppose if its not valuable. To avoid using these SSMIA is also another way of good option.

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Study	Approach	Dataset used	Limitation
		professional network profiles.	
Labor market economic studies	Economic model and statistical	Relies on aggregated government and labor market data.	Does not account for personal skill development or localized student data.
Resume–job matching systems	keyword-based matching	Based on static resume data and standard job descriptions.	Often inaccurate as it measures keywords rather than true skill proficiency.
SSMIA (Proposed)	ML + NLP framework + Survey	Integrates granular student data with real-time market intelligence	Currently focused on regional data; requires scaling for global application.

B. Industry Requirement Benchmarks

The Evaluated industry job data to see how often the specific skills were mentioned. This Demand-Frequency how jobs are posting listed skills as the requirement, like DevOps and Data Analysis, and also the bench marks comes from the weighted average across seven key roles including Software and ML.

But in current tech world most of the new techniques, tools, programming language ,like that by improving these kind of thing in the company, the graduate students can able to adapt that easily by in this case where the benchmarks and job demand increasing and real world facing struggle is real.

Each study used each approach but most of the time each study used to connect with the multiple approach . Even programming languages like python have been used all around the world even though it used to work in multiple ways in this case.

Even the new trends are also growing in the tech world like Prompt engineering where its used in LLM and accurate, relevant and the high quality output . These kinds of trends are also growing around the tech world.

Table I. Comparison of related approaches vs. SSMIA (proposed)

Study	Approach	Dataset used	Limitation
Educational data mining approaches	ML	LMS logs, grades	Lacks alignment with actual industry requirements or job market shifts
Job market analysis platforms	NLP	Analyzes live job postings	Fails to integrate individual student skills
Labor market economic studies	Economic model and statistical	Labor market data analysis	Does not account for personal skill development or localized data
Resume–job matching systems	Keyword-based matching	Based on static resume data	Measures keywords rather than true skill proficiency
SSMIA (Proposed)	**ML + NLP framework + Survey**	Student data in real-time market intelligence	Currently focused on regional data; requires scaling for global use

** SSMIA row highlighted — proposed system addresses gaps of all prior approaches*

C. Key Findings and Gap Analysis

Finding the real data between the gap and measure

then finding the lacking area then measuring and taking reports and dashboards insights were also easy to analyze and also able to find the area. In this where we are using so that we are able to analyze the future prediction and past lacking areas.

Where it's also helpful for data analytics and students to find and predict the upcoming scoopful and valuable to improve their skills and be able to get their job .

This is the common thing to measure and make dashboards to find the difference , and also be able to predict the future and society used to change by those insights.

So basically Key finding is what you discover, what new, valuable and improvement data has been collected for leading the SSMIA.

Coming to the next point where the Gap analysis is a problem because where its used to find the problem why and where it lack what job demand and why students does not have it the skill they required and the why jobs are not accepting the some lacking students skills.

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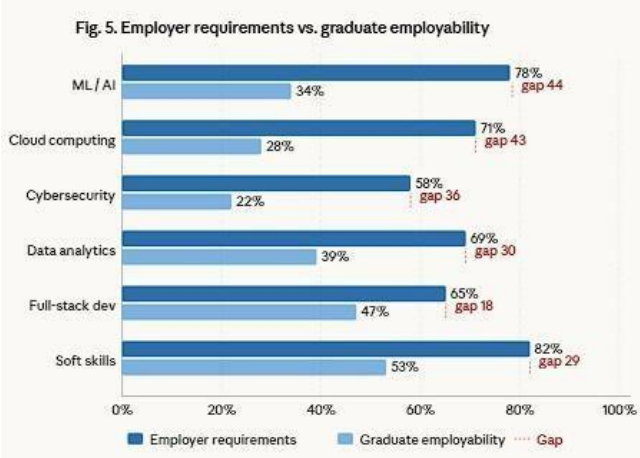


Students most of time used to see reports and dashboards analysis by themselves without any unnecessarily fake advice where this SSMIA gives real time data and also this SSMIA used to measure the gap between the job demands and students skills in the real time data.

V. CONCLUSION

The Student Skill Market Imbalance Analyzer (SSMIA) helps us to see the gap between what engineering students know and what companies want. It looks like a student's guidance for their next step, requirements by analyzing survey data alongside in the job market trends. The data used to show that the students struggle to meet their marks in the tough areas like ML and Cybersecurity.

By using the supervised machine learning, helps the most of the college student to find the next step career, this Student Skill Market Imbalance Analyzer (SSMIA) leads them for taking the next step so that they can able to find one success point the career

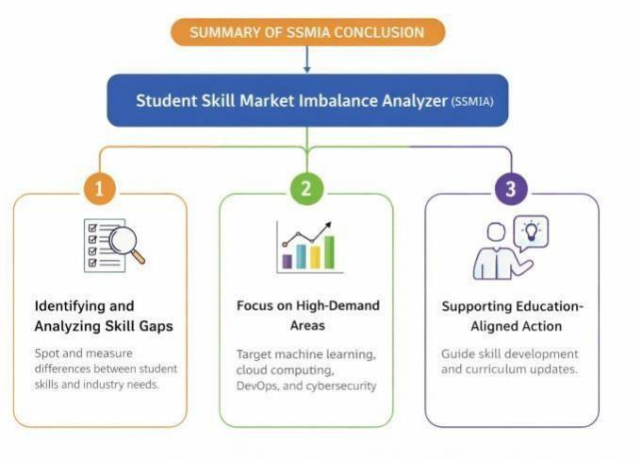
By this, the Student Skill Market Imbalance Analyzer (SSMIA) is able to find and see the prediction for the high scope studies.

In real world system especially in the tech world by this research, everyone can able to get their job without any worrying after the graduation so the Job-ready statement would be fit for the students without any tension and can able to use in real - world

So that upcoming students have used this tool and improved their skills by that where the work demand would be reduced so that the employee no need to struggle to find a right candidate which is actually helpful for the job demand side and also in the job point of view their rate also used to increase, so that they able to things insights.

So totally it works on collecting data , identifying and analyzing and finding the skill gaps between the students skills and industry demands in this case the 2nd step is none- other than focusing on high demand areas by that where the values and scopes begin valued and growing target that area focus on that it would like a ML, cloud computig,DevOps.

And after all these the supporting education - Aligned Action has been used clearly for the students they will have guidance for the next steps. Even the Excel data manage continues to be assisted and for engineering management its used to give same accuracy value like before it never fades, even new generation people are also using it that things that kind of powerful tool existed.



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