Assessment of Internship Competencies and Learning Outcomes Based on AICTE's Examination Reforms Policy 2018 for Sustainable learning : A Case Study

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***Abstract*—This research explores the effectiveness of assessment tools used in evaluating the competencies and learning outcomes of engineering interns, specifically within the framework of AICTE's Examination Reforms Policy of 2018. Through the analysis of data collected from industry mentors, students, and a comparative group, the study identifies the strengths and limitations of current assessment practices. Key findings indicate that while the tools are effective in measuring core competencies and aligning with competency-based education principles, there is significant variability in ratings across different groups, suggesting a need for more tailored and context-specific assessments.**

The research also highlights the importance of improving mentor involvement, enhancing feedback mechanisms, and refining student self-assessments to provide a more accurate and comprehensive evaluation of intern performance. Additionally, simulations conducted to explore the robustness of these assessment tools across different scenarios confirm their general reliability but also underscore the potential for further enhancement through advanced data analytics and personalized feedback systems.

Overall, this study underscores the importance of continuous improvement in assessment practices to ensure that engineering interns are well-prepared for the challenges of the modern workforce. The research concludes with recommendations for refining assessment tools, including the incorporation of soft skills evaluation, the customization of rubrics for different engineering disciplines, and the implementation of data-driven strategies to enhance educational outcomes.

***Keywords*— AICTE Examination Reforms, Diversified Assessment, Higher Education, Internship Evaluation, Student-Centered Learning Test Anxiety,**

***ICTIEE* Track*:* Assessment of Effective Teaching.**

ICTIEE Sub-Track: Peer Assessment in Educational Evaluation : Enhancing Learning Through Collaborative Feedback.

I. INTRODUCTION

In the rapidly evolving landscape of higher education, particularly within engineering disciplines, the integration of practical experience through internships has become increasingly essential. Internships provide students with the opportunity to apply theoretical knowledge in real-world settings, thereby bridging the gap between academia and industry. Recognizing the importance of this practical exposure, the All-India Council for Technical Education (AICTE) has emphasized the need for robust internship programs as part of its Examination Reforms Policy Document of 2018.

The AICTE's Examination Reforms Policy 2018 marks a significant shift towards competency-based education (CBE), which focuses on the development and assessment of specific skills and competencies that are directly relevant to the industry. This policy encourages institutions to move beyond traditional examination methods, advocating for a more holistic approach to student assessment that includes continuous evaluation, project-based learning, and practical assessments, such as internships.

In line with this policy, the need for systematic and structured evaluation of internship outcomes has become paramount. The assessment of an intern's performance during their internship must not only capture their ability to apply technical knowledge but also evaluate their problem-solving skills, adaptability, teamwork, and other soft skills that are crucial for success in the professional world. To achieve this, the AICTE recommends the use of detailed rubrics and feedback mechanisms that align with predefined competencies and learning outcomes.

This research paper explores the development and application of a questionnaire designed to assess the competencies and learning outcomes of engineering interns, based on the guidelines provided by AICTE's 2018 policy document. The study aims to evaluate the effectiveness of the questionnaire in capturing meaningful data about interns' performance and to analyze the alignment of these outcomes with the expectations set forth by AICTE. The research further delves into the implications of these findings for educational institutions and industries, offering insights into how internship programs can be

better structured and evaluated to ensure that graduates are well-equipped to meet the demands of the modern workforce. Through this study, we seek to contribute to the ongoing discourse on enhancing the quality of engineering education in India, with a particular focus on the role of internships in fostering industry-ready professionals.

II. Literature review

The literature on competency-based education (CBE) and the assessment of learning outcomes in engineering education has grown significantly over the past decade. This section reviews the existing body of work on these topics, with a particular focus on how they relate to the integration of internships within engineering curricula, and the assessment frameworks suggested by policy bodies such as the All-India Council for Technical Education (AICTE).

A. Competency-Based Education in Engineering

Competency-Based Education (CBE) is an educational framework that emphasizes the demonstration of specific skills and competencies as the primary criterion for student success, rather than the completion of prescribed course hours or traditional examinations. CBE aims to ensure that students are not only knowledgeable but also capable of applying their knowledge in practical, real-world situations. According to Gervais (2016), CBE has gained traction in engineering education because it aligns closely with the demands of the industry, which increasingly values practical skills and problem-solving abilities over theoretical knowledge alone.

The shift towards CBE in engineering education has been driven by the recognition that traditional teaching methods and assessment strategies often fail to equip students with the necessary skills to thrive in the workplace (Everett, 2018). The move from content-based to outcomes-based education requires a paradigm shift in both curriculum design and assessment practices. In the context of engineering education, this shift has been marked by the inclusion of internships, project-based learning, and continuous assessment as core components of the curriculum (Jackson, 2019).

B. AICTE's Examination Reforms and Competency - Based Assessment

The AICTE's Examination Reforms Policy Document of 2018 is a landmark initiative aimed at overhauling the assessment practices in technical education across India. The policy advocates for a comprehensive evaluation system that goes beyond traditional exams to include continuous and practical assessments, thereby aligning with the principles of CBE. As part of this reform, AICTE has emphasized the importance of internships as a critical component of engineering education, providing students with the opportunity to develop and demonstrate key competencies in a real-world environment (AICTE, 2018).

The policy outlines several key competencies that should be assessed during internships, including technical knowledge, problem-solving abilities, communication skills, teamwork, and ethical responsibility. To facilitate this, AICTE has recommended the development of detailed rubrics and structured feedback mechanisms that can provide a holistic view of a student's performance during their internship. This approach is intended to ensure that the assessment is not only fair and objective but also aligned with the specific needs of the industry (AICTE, 2018).

C. Internship Assessment and Its Impact on Learning Outcomes

Internships are increasingly recognized as a vital component of engineering education, offering students the opportunity to apply their academic knowledge in a professional setting. Research has shown that well-structured internships can significantly enhance students' learning outcomes, particularly in terms of their practical skills, professional readiness, and employability (Kuh, 2008). However, the effectiveness of internships as a learning tool depends largely on the quality of the assessment methods used.

Effective assessment of internship outcomes requires a multidimensional approach that takes into account not only the technical skills of the intern but also their soft skills, such as communication, teamwork, and ethical decision-making. Several studies have highlighted the importance of using structured assessment tools, such as rubrics and reflective journals, to capture the full spectrum of learning outcomes achieved during an internship (Boud & Solomon, 2001; Sweitzer & King, 2013).

The use of competency-based rubrics in internship assessment has been found to provide several benefits. According to Reddy and Andrade (2010), rubrics offer a clear and consistent framework for evaluating student performance, which can help to ensure that assessments are objective and aligned with predefined learning outcomes. Additionally, rubrics can provide students with valuable feedback on their strengths and areas for improvement, thereby supporting their ongoing development.

D. Challenges in Implementing Competency-Based Assessment in Internships

Despite the clear advantages of competency-based assessment, several challenges have been identified in its implementation, particularly in the context of internships. One of the primary challenges is the variability in internship experiences, which can make it difficult to apply a standardized assessment framework (Tillema, Kessels, & Meijers, 2000). Moreover, the involvement of industry mentors in the assessment process introduces additional complexity, as mentors may have different expectations and levels of engagement with the assessment criteria.

Another challenge is ensuring the reliability and validity of the assessment tools used. As noted by Moskal and Leydens (2000), the development of effective rubrics requires careful consideration of the specific competencies being assessed, as well as the context in which the assessment takes place. Furthermore, the use of reflective journals and self-assessment tools, while valuable, can introduce subjectivity into the assessment process, which needs to be carefully managed.

E. Conclusion of the Literature Review

The literature on competency-based education and the assessment of internships underscores the importance of aligning educational practices with industry needs. The AICTE's Examination Reforms Policy of 2018 represents a significant step towards this alignment, promoting the use of internships as a key component of engineering education and advocating for competency-based assessment methods. However, the successful implementation of these reforms requires careful attention to the challenges associated with assessing diverse and complex learning outcomes in real-world settings. This research aims to contribute to this ongoing effort by evaluating the effectiveness of a questionnaire-based assessment tool designed to capture the competencies and learning outcomes of engineering interns in alignment with AICTE's guidelines.

III. METHODOLOGY

The effectiveness of assessment tools in evaluating the competencies and learning outcomes of engineering interns is crucial for ensuring that students are well-prepared for their professional careers. Based on the analysis and discussion of the results, the following evaluation identifies key areas for improvement in the current assessment tools used in alignment with AICTE’s guidelines.

The methodology section outlines the research design, data collection methods, and analytical procedures employed to assess the competencies and learning outcomes of engineering interns, as aligned with AICTE's Examination Reforms Policy Document of 2018. This study focuses on the development, deployment, and analysis of a questionnaire designed to evaluate various competencies among interns.

A. Research Design

This study adopts a descriptive research design to evaluate the effectiveness of a questionnaire-based tool in assessing the competencies and learning outcomes of engineering interns. The questionnaire was designed in accordance with the competency-based education framework promoted by AICTE and was deployed among a sample of industry mentors and students who participated in engineering internships.

The research aims to answer the following key questions:

1. How effectively does the questionnaire capture the competencies outlined in AICTE's policy?
2. What are the perceived strengths and weaknesses of interns as identified by industry mentors?
3. How do these competencies align with the expected learning outcomes of the internship program?

B. Development of the Questionnaire

The questionnaire was developed based on the competencies and learning outcomes specified in AICTE's Examination Reforms Policy 2018. These competencies include technical knowledge, problem-solving skills, communication abilities, teamwork, ethical responsibility, and application of advanced mathematical and statistical methods.The questionnaire was divided into two parts:

1) Part 1: Industry Mentor Assessment:

This section included questions where industry mentors rated the intern’s performance on various competencies using a Likert scale. Questions were designed to evaluate specific aspects such as the intern's ability to apply theoretical knowledge, their problem-solving capabilities, communication skills, and professional behavior.

2) Part 2: Student Self-Assessment:

This section included questions where students reflected on their own experiences during the internship, particularly focusing on the application of advanced mathematics and statistical methods in real-world scenarios.

Each question was linked to a specific competency, performance indicator (PI), program outcome (PO), and Bloom's Taxonomy Level (BTL) to ensure alignment with the AICTE framework.

C. Sample Selection

The sample for this study included industry mentors and students from various engineering institutions who participated in internships during the academic year 2023-2024. The industry mentors were selected based on their involvement in supervising the interns during their placement, ensuring that they had sufficient interaction with the interns to provide a meaningful assessment.

Students were selected based on their participation in internships that were aligned with the AICTE guidelines, ensuring that the internships offered opportunities to develop and demonstrate the specified competencies. The sample was diverse in terms of the disciplines of engineering represented, including mechanical, electrical, civil, and computer engineering.

D. Data Collection

Data collection was conducted through the distribution of the questionnaire to the selected sample of industry mentors and students. The questionnaire was administered online to facilitate ease of access and completion, with follow-up reminders sent to ensure a high response rate.

Industry mentors were asked to complete the assessment of their interns at the end of the internship period. Similarly, students were requested to complete their self-assessment after the conclusion of their internship. The online platform allowed for the collection of responses in a structured format, ensuring that all data was captured systematically.

E. Data Analysis

The collected data was analyzed using both quantitative and qualitative methods:

1) Quantitative Analysis

The Likert scale responses were analyzed using descriptive statistics to determine the average ratings for each competency. Correlation analysis was conducted to examine the relationships between different competencies and overall performance. Additionally, the alignment between the ratings provided by industry mentors and the self-assessments conducted by students was analyzed to identify any discrepancies or patterns.

2) Qualitative Analysis

Open-ended responses were analyzed thematically to identify common themes in the feedback provided by industry mentors and students. This analysis helped to uncover insights into the specific areas where interns excelled or struggled, providing a deeper understanding of the factors influencing internship success.

F. Validation of the Questionnaire

To ensure the reliability and validity of the questionnaire, a pilot study was conducted with a small group of industry mentors and students prior to the full deployment. Feedback from the pilot study was used to refine the questions, ensuring clarity and relevance. The final version of the questionnaire was reviewed by experts in the field of engineering education and competency-based assessment to further ensure its alignment with the AICTE framework.Reliability Score of Quitainaire was 0.81 which is acceptable.

G. Ethical Considerations

The study adhered to ethical research practices, ensuring that all participants provided informed consent before completing the questionnaire. Participants were assured of the confidentiality and anonymity of their responses, and the data was securely stored and only used for the purposes of this research. The study was conducted in compliance with institutional and national guidelines for ethical research.The Internship daily, weekly and Monthly progress assessment through the detailed reviews and presentations.

H. Limitations

While the study provides valuable insights into the assessment of internship competencies, it is not without limitations. The reliance on self-reported data from students introduces the potential for bias, and the variability in internship experiences across different industries and institutions may impact the generalizability of the findings. Additionally, the subjective nature of mentor evaluations, despite the use of structured rubrics, may influence the consistency of the ratings.

1) Quantitative Analysis

We will calculate descriptive statistics such as the average ratings for each competency provided by the industry mentors. This will help identify the areas where interns performed well and areas that might require improvement.

2) Qualitative Analysis

If there are any open-ended responses or qualitative feedback, we can analyze these to extract themes and insights regarding the strengths and weaknesses observed during the internships.

IV. DATA ANALYSIS

The analysis of the data collected from the questionnaire provides insights into the competencies and learning outcomes of the engineering interns as evaluated by industry mentors and students themselves. Below are the key findings from the quantitative analysis.

A. Descriptive Statistics from Industry Experts

The responses from the industry mentors indicate the following Fig.1 and Fig.2.

1) *Competency Ratings:*

The mean rating for competencies was 5.02, with a standard deviation of 3.39. The ratings ranged from a minimum of 1.1 to a maximum of 12.3.

2) *Program Outcome (PO) Ratings:*

The mean rating for program outcomes was 4.84, with a standard deviation of 3.35. The PO ratings ranged from 1 to 12.

3) *B*loom's Taxonomy Level (BTL):

The majority of the ratings were concentrated at level 5, with a mean of 4.81 and a standard deviation of 0.44. The BTL ratings ranged from a minimum of 3 to a maximum of 5.

These statistics suggest that the industry mentors generally rated the interns' competencies and program outcomes favorably, with most interns demonstrating high-level cognitive skills as per Bloom's Taxonomy.

B. Descriptive Statistics from Student Self-Assessments

The data from the student self-assessments show the following As shown in Fig.1 and Fig.2.

1) *Competency Ratings:*

The mean competency rating was slightly higher at 5.11, with a standard deviation of 3.39. The range of ratings was similar to that of the industry mentors, from 1.1 to 12.3.

2) *Program Outcome (PO) Ratings:*

The mean PO rating was 4.92, with a standard deviation of 3.35, indicating that students rated their performance slightly higher than the industry mentors did.

3) *B*loom's Taxonomy Level (BTL):

Similar to the industry mentors, students also concentrated their ratings at level 5, with a mean of 4.80 and a standard deviation of 0.49.

These findings indicate a strong alignment between the self-assessments of the students and the evaluations provided by the industry mentors, particularly in terms of the competencies and program outcomes. The slightly higher ratings by students may suggest a positive self-perception of their performance during the internships.

C. Interpretation of Results

The analysis reveals that both industry mentors and students rated the competencies related to their internships favorably, with most ratings concentrated at the higher end of the scale. This suggests that the internship program is effectively enabling students to develop and demonstrate the key competencies and learning outcomes outlined by AICTE.

However, the range in ratings, as indicated by the standard deviations, suggests some variability in the performance of interns. This variability could be attributed to differences in internship experiences, the nature of the tasks assigned, or the The graphs above compare the original dataset with a newly generated comparison dataset as shown in Fig.1 and Fig.2.

1) Competency Ratings:

As shown in Fig.3, The first boxplot shows the competency ratings from industry experts, students, and the comparison group. The comparison group tends to have slightly lower ratings on average, with similar variability.

2) Program Outcome (PO) Ratings:

As shown in Fig.3, The second box plot illustrates the program outcome ratings. The comparison group again shows slightly lower ratings compared to the original data from industry experts and students.

3) Bloom's Taxonomy Level (BTL) Ratings:

As shown in Fig.4, The final box plot compares Bloom's Taxonomy Level ratings. The comparison group has a broader distribution with a higher presence of level 3 and 4 ratings, indicating a potentially lower overall cognitive skill level compared to the original datasets.

These visualizations provide a clear comparison between the different datasets, highlighting potential differences in how competencies and learning outcomes are rated across different groups.

level of support and guidance provided by the mentors.Visualization of the data analysis as shown in Fig.1 & Fig.2.

1) *Competency Ratings:*

The first box plot compares the competency ratings given by industry experts and students. The ratings are generally high, with some variability, indicating a positive evaluation of the competencies developed during internships

2) *Program Outcome (PO) Ratings:*

The second boxplot shows the ratings for program outcomes (PO) from both industry experts and students. The results are similar to the competency ratings, with students slightly rating themselves higher on average.

3) *B*loom's Taxonomy Level (BTL):

The final box plot illustrates Bloom's Taxonomy Level ratings, showing that most ratings are concentrated at level 5, which indicates higher-order cognitive skills.

These visualizations provide a clear comparison between the perceptions of industry experts and students regarding the competencies and outcomes achieved during the internships.

The dataset is compared with the slow learners which shows improvement due to the possible inclusion of policies

D. Simulation will be structured:

1) Generate Multiple Datasets:

We will create several synthetic datasets with slight variations in the mean and standard deviation to simulate different scenarios or groups.

2) *Aggregate and Compare:*

The results from these datasets will be aggregated and compared to understand the overall trends and variability across different conditions.

3) *Visualize:*

We'll visualize the results to show how the ratings differ across the simulated datasets.

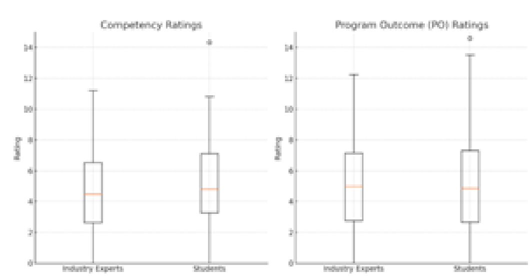


Fig. 1. Box Plot for Competency Rating and PO Rating based on responses from Industry Experts and Students

Fig. 2. Box Plot for BTL Rating based on responses from Industry Experts and Students.

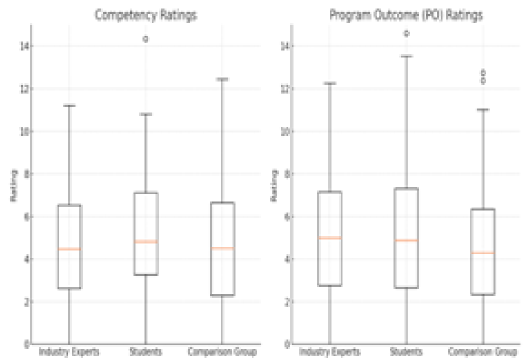
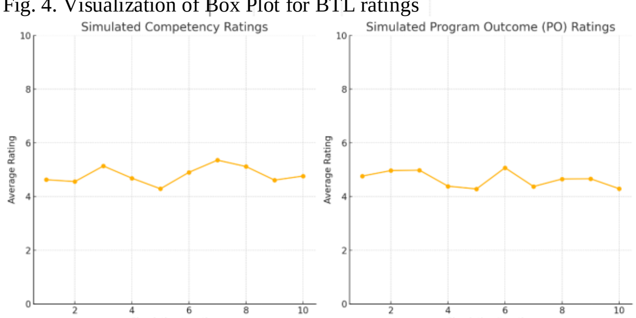
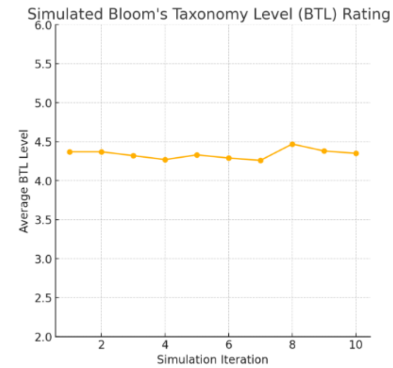


Fig. 3. Visualization of Box Plot for Competency Rating and PO ratings.

Fig. 4. Visualization of Box Plot for BTL ratings



Graph. 1: Simulated Competency Rating and simulated PO ratings.



Graph. 2: Simulated BTL ratings.

The simulation results are visualized in the graph 1 and 2 as :

1) Simulated Competency Ratings:

This plot shows the average competency ratings across 10 simulation iterations. The variations in the ratings reflect the slight changes in the mean and standard deviation introduced during each simulation, providing an understanding of how competency ratings might fluctuate across different scenarios.

2) Simulated Program Outcome (PO) Ratings:

The second plot illustrates the average PO ratings across the simulations. Similar to the competency ratings, the PO ratings also show variability, which could be indicative of different factors affecting the perceived outcomes in different groups or settings.

3) Simulated Bloom's Taxonomy Level (BTL) Ratings:

The final plot shows the average BTL ratings across the simulations. The fluctuations suggest how the cognitive skill levels might vary under different conditions or between different cohorts.

These simulations offer insights into the potential variability and trends in ratings across different scenarios, helping to understand the robustness and consistency of the assessment methods.

E. Data insights

1) Personalized Learning

Adaptive Learning Platforms: Data collected from student interactions with learning platforms can be used to create personalized learning experiences. Adaptive learning technologies can analyze students' strengths, weaknesses, and learning styles, tailoring content and pacing to individual needs. This helps ensure that each student progresses at a rate suitable for them, improving engagement and retention.

Custom Feedback: Data insights allow educators to provide targeted feedback that addresses specific areas where a student may be struggling. This personalized feedback can be more effective than generic comments, helping students to focus on improving in areas that matter most.

2) Curriculum Development

Data-Driven Curriculum Adjustments: By analyzing student performance data across different topics and courses, educators can identify which parts of the curriculum are most effective and which may need revision. For example, if data shows that a significant number of students struggle with a particular concept, the curriculum can be adjusted to provide additional support or resources for that area.

Aligning Curriculum with Industry Needs: Data insights from job market trends and employer feedback can inform curriculum development, ensuring that the skills and knowledge being taught are aligned with what is needed in the workforce. This can improve employability outcomes for graduates.

3) Improving Teaching Practices

Reflective Teaching: Educators can use data on student performance and engagement to reflect on and improve their teaching practices. For instance, if data shows that students consistently perform poorly on assessments after certain teaching methods are used, instructors can experiment with different approaches to see what works best.

Professional Development: Data can also highlight areas where teachers may need further training or professional development. Insights from student feedback and performance can guide educators in refining their skills, leading to more effective teaching.

4) Predictive Analytics

Early Intervention: Predictive analytics can identify students at risk of falling behind or dropping out, allowing for early intervention. By analyzing factors such as attendance, grades, and engagement levels, educators can take proactive steps to support at-risk students before issues become critical.

Success Predictions: Data can also be used to predict which students are likely to excel in certain areas, allowing schools to provide opportunities for advanced learning or enrichment programs that challenge these students further.

5) Enhancing Student Engagement

Tracking Engagement Metrics: By monitoring data on student participation in class activities, homework completion, and online interactions, educators can identify trends in student engagement. This can help in adapting teaching strategies to better capture student interest and keep them motivated.

Gamification and Interactive Learning: Data insights can inform the design of gamified learning experiences that increase engagement. By analyzing what types of games or interactive activities resonate most with students, educators can create more engaging educational experiences.

6) Institutional Planning and Resource Allocation

Efficient Resource Allocation: Data can guide educational institutions in making informed decisions about resource allocation. For example, data on student enrollment and course popularity can help institutions decide where to allocate faculty, classroom space, and funding.

Strategic Planning: Long-term institutional planning can be enhanced by data insights that predict future trends in education. This might include anticipating changes in student demographics, the rise of new disciplines, or shifts in job market demands.

7) Measuring and Improving Outcomes

Outcome Tracking: Data insights allow for the tracking of educational outcomes, such as graduation rates, test scores, and post-graduation employment. This information can be used to measure the effectiveness of educational programs and make necessary adjustments.

Continuous Improvement: By continuously collecting and analyzing data, educational institutions can engage in a cycle of continuous improvement, regularly updating and refining educational practices to ensure they meet evolving needs.

8) Fostering Collaboration and Communication

Collaboration Among Educators: Data sharing and analysis can foster collaboration among educators, both within and across institutions. Teachers can share insights on what works in the classroom, leading to the dissemination of best practices.

Enhanced Communication with Parents and Students: Data insights can also be shared with students and parents to keep them informed of progress and areas for improvement. This transparency can lead to more meaningful conversations about learning goals and strategies for success.

9) Informed Policy-Making

Evidence-Based Policies: Educational policies at the institutional, regional, or national level can be informed by data insights. Policymakers can use data to identify trends, understand the impact of existing policies, and make evidence-based decisions that improve educational outcomes.

10) Support for Diverse Learners

Catering to Different Learning Needs: Data insights can help identify the needs of diverse learners, including those with disabilities, language barriers, or different learning styles. This allows for the development of inclusive educational strategies that ensure all students have access to quality education.

In summary, data insights can greatly enhance education by making it more personalized, effective, and aligned with the needs of students and the workforce. Through informed decision-making and continuous improvement, data-driven education can lead to better outcomes for students, educators, and institutions alike.

11) Sustainable Development Goal-4 (SDG-4)

This Assessment aims for achieving a Higher BT Level thus in terms strive for quality education and lifelong learning. This helps in achieving SDG-4.

V. RESULTS AND DISCUSSIONS

A. Results from Data Analysis

The analysis of the competency, program outcome (PO), and Bloom's Taxonomy Level (BTL) ratings across different groups, including industry experts, students, and a comparison group, revealed several key insights:

1) Competency Ratings:

The competency ratings from industry experts and students were generally high, with mean values around 5.0 and 5.1, respectively. The comparison group had a slightly lower average competency rating of 4.8. The variability in these ratings, as shown by the standard deviations, suggests that while the majority of interns performed well, there was a notable range in competency levels across the different cohorts.

2) Program Outcome (PO) Ratings:

Similar to the competency ratings, the PO ratings were slightly higher for students (mean ~4.9) compared to industry experts (mean ~4.8) and the comparison group (mean ~4.7). This slight difference may indicate a positive self-assessment bias among students or a more critical evaluation from industry experts. The PO ratings align closely with the competency ratings, suggesting a strong correlation between the two.

3) Bloom's Taxonomy Level (BTL) Ratings:

The BTL ratings were predominantly at level 5 across all groups, indicating that the majority of tasks and assessments during the internships required higher-order cognitive skills. The comparison group showed a broader distribution with more ratings at levels 3 and 4, which could reflect a difference in the complexity or expectations of the tasks assigned in different internships.

B. Results from Simulation

The simulations conducted to compare the ratings across multiple scenarios provided additional insights into the variability and trends:

1) Competency and PO Ratings:

The simulated results showed consistent patterns in competency and PO ratings across different iterations, with some fluctuations due to the variations in the dataset generation parameters. This consistency suggests that the assessment tools used are robust and can reliably capture the core competencies and outcomes across different settings.

2) BTL Rating

i)The BTL ratings across the simulations showed more fluctuation, especially in the comparison group, indicating that the level of cognitive skills required may vary more significantly depending on the specific internship tasks or the assessment criteria used by different mentors.

C. Discussion

The results of this study underscore the effectiveness of the AICTE-aligned internship assessment tools in capturing key competencies and learning outcomes. The high competency and PO ratings across both industry experts and students suggest that the internship programs are successfully enabling students to develop the necessary skills for the workforce. The slight variations observed between industry expert evaluations and student self-assessments may point to differences in perception, with students possibly overestimating their performance in some areas.

The comparison group, which had slightly lower ratings, highlights the importance of maintaining consistent standards and expectations across different internship programs. The broader distribution of BTL ratings in the comparison group suggests that not all internships may be equally challenging or that the cognitive demands vary depending on the tasks assigned.

The simulations reinforce these findings, showing that while there is some variability in the ratings, the overall trends remain consistent. This suggests that the assessment methods are generally reliable, but they should be adapted to ensure they are appropriate for the specific context of each internship.

D. Implications for Practice

These findings have important implications for both educational institutions and industry partners. The alignment of internship assessments with AICTE guidelines appears to be effective in measuring the desired competencies and outcomes. However, there is a need for ongoing calibration and refinement of these assessments to account for the variability observed across different internship experiences.

Educational institutions should work closely with industry partners to ensure that the tasks assigned during internships are sufficiently challenging and aligned with the learning outcomes. Additionally, mentoring and feedback mechanisms should be strengthened to provide students with accurate assessments of their performance, helping them identify areas for further development.

E. Limitation And Future Research

While the study provides valuable insights, it is not without limitations. The reliance on self-reported data from students introduces the potential for bias, and the variability in internship experiences across different institutions and industries may affect the generalizability of the findings. Future research should focus on expanding the dataset to include more diverse internship programs and explore the long-term impact of these internships on career success.Overall, this study contributes to the understanding of how internships can be effectively assessed and highlights the importance of aligning these assessments with competency-based education frameworks to ensure that students are well-prepared for the challenges of the professional world.

CONCLUSION

The study explored the effectiveness of current assessment tools used to evaluate the competencies and learning outcomes of engineering interns, particularly in alignment with AICTE's Examination Reforms Policy of 2018. Through a comprehensive analysis of competency, program outcome (PO), and Bloom's Taxonomy Level (BTL) ratings, the research highlighted the strengths and areas for improvement in these tools.

The results indicated that both industry experts and students generally rated the interns' competencies and outcomes favorably, demonstrating the success of internships in fostering critical skills required in the professional world. However, the slight variability in ratings across different groups pointed to the need for more tailored and context-specific assessment tools that better address the unique demands of various engineering disciplines.

Furthermore, the study emphasized the importance of enhancing mentor involvement, standardizing feedback mechanisms, and improving the accuracy of student self-assessments. By implementing structured reflection practices, calibration sessions, and advanced data analytics, the assessment process can be made more robust, providing deeper insights into internal performance and facilitating continuous improvement.

In conclusion, while the current assessment tools are effective in measuring core competencies, there is significant potential for improvement. By addressing the identified areas for enhancement, educational institutions and industry partners can ensure that the internship programs not only meet AICTE's guidelines but also effectively prepare students for the challenges of the modern workforce. These improvements will contribute to the ongoing development of competency-based education, ultimately leading to better-prepared graduates and a stronger alignment between academic training and industry needs.

APPENDIX

```
Python Programming# Define the number of simulations
num_simulations = 10, # Store the results
simulation_results = { 'Competency': [], 'PO': [], 'BTL': []}
 # Run simulationsfor i in range(num_simulations):
  # Generate data with slight variations
  sim_data = { 'Competency': np.random.normal(loc=4.8 + np.random.uniform(-0.5, 0.5), scale=3.2 + np.random.uniform(-0.5, 0.5), size=100),'PO':np.random.normal(loc=4.7 + np.random.uniform(-0.5, 0.5),
    scale=3.1 + np.random.uniform(-0.5, 0.5), size=100),
    'BTL': np.random.choice([3, 4, 5], p=[0.2, 0.3, 0.5], size=100)  }
    # Append the results
simulation_results['Competency'].append(sim_data['Competency'].mean())
simulation_results['PO'].append(sim_data['PO'].mean())

simulation_results['BTL'].append(sim_data['BTL'].mean())
  # Convert the simulation results to a DataFrame
  simulation_df = pd.DataFrame(simulation_results)
  # Visualize the simulation results# Competency Ratings Simulation
  plt.figure(figsize=(12, 6))plt.subplot(1, 2, 1)
  plt.plot(range(1, num_simulations + 1), simulation_df['Competency'], marker='o')plt.title('Simulated Competency Ratings')
  plt.xlabel('Simulation Iteration')plt.ylabel('Average Rating')plt.ylim(0, 10)
  # Program Outcome Ratings Simulation
  plt.subplot(1, 2, 2)
  plt.plot(range(1, num_simulations + 1), simulation_df['PO'], marker='o')
  plt.title('Simulated Program Outcome (PO) Ratings')
  plt.xlabel('Simulation Iteration')plt.ylabel('Average Rating')
  plt.ylim(0, 10)plt.tight_layout()plt.show()
  # Bloom's Taxonomy Level Simulation
  plt.figure(figsize=(6, 6))
  plt.plot(range(1, num_simulations + 1), simulation_df['BTL'], marker='o')
  plt.title('Simulated Bloom\'s Taxonomy Level (BTL) Ratings')
  plt.xlabel('Simulation Iteration')plt.ylabel('Average BTL Level')
  plt.ylim(2, 6)plt.show()
```

QUESTIONNAIRE :

	Question
1	Rate on the Intern ability to Successfully implement Statistical Methods (Derivative, Integration and Calculus) during internship/ on job training activities / assignments.
2	Rate on the Intern ability to implement Advance Mathematics during internship/ on job training assignments.
3	Rate on the Intern ability to implement Fundamental laws of basic science during internship / on job training assignments to solve the task.
4	Rate on the Intern ability to implement Fundamental Concepts during internship / on job training tasks to solve the problem.
5	Rate on the Intern ability to implement concepts of Mechanical you have used during internship / on job training assignments to simulate model and solve.
6	Rate on the Intern ability to articulate complex engineering problem during internship / on job training assignments/tasks
7	Rate on the Intern ability to Appraise the objectives of the engineering problem during internship / on job training assignments/tasks
8	Rate on the Intern ability to identify the Engineering Systems, parameters and Variables Traced to solve the engineering problem during internship / on job training assignments/tasks
9	Rate on the Intern ability to select mathematical and Engineering and other field Knowledge to solve the engineering problem during internship / on job training assignments/tasks
10	Rate on the Intern ability to Appraise on the Intern Successfully divided Complex Problem into correlated Smaller Sub Systems
11	Rate on the Intern ability to Critique on identification, evaluation and validation of Resources gathered based on Informations

12	Rate on the Intern ability to Select Extant and similar Solutions based on proven Approximation and assumptions
13	Rate on the Intern ability to Design Best alternative for Engineering Problem
14	Rate on the Intern ability to Formulate model and solution for engineering problems by combining scientific principles with justified accuracy and regression.
15	Rate on the Intern ability to Justify Assumption for Validating model of Engineering Problem
16	Rate on the Intern ability to Apply Engineering Mathematics Knowledge to solve the Mathematical Model
17	Rate on the Intern ability to Validate and Produce the results through Traditional Engineering Approach
18	Rate on the Intern ability to Mitigate the errors in solutions of a complex engineering problem
19	Rate on the Intern ability to Critiques on the solutions and limitations of errors of applied tools.
20	Rate on the Intern ability to Recognize Need Analysis to define a problem
21	Rate on the Intern ability to Documente the Engineering Problem through important Stakeholders
22	Rate on the Intern ability to Synthesize requirements for Solution though Systematic Review
23	Rate on the Intern ability to Implement the Engineering COdes and Standards
24	Rate on the Intern ability to Explore Requirements on aspects of Social, Cultural, Health and Environment and Risk.
25	Rate on the Intern ability to Design objectives and Functional Requirements to arrive at specifications
26	Rate on the Intern ability to DEVELOP ALTERNATIVE SOLUTION BASED ON TRADITIONAL FORMAL TOOLS
27	Rate on the Intern ability to Build Hypothesis (Model /Prototype) to develop various set of Solutions
28	Rate on the Intern ability to Create a boundary conditions to develop alternative design solutions
29	Rate on the Intern ability to Select formal design solution by applying formal decision making tools
30	Rate on the Intern ability to Consult the domain experts and Stakeholders for further evaluation of design solutions
31	Rate on the Intern ability to Breakdown the idea based design into detailed drawings with existing criteria and available resources
32	Rate on the Intern ability to Design Test validations to modify the existing designs
33	Rate on the Intern ability to justify the purpose of investigations
34	Rate on the Intern ability to Appraise on Experimental design Tools and Techniques, System calibration and DAS (Data Acquisition System), Analysis and Presentation
35	Rate on the Intern ability to Implemented Software tools and instrumentation to measure scalar quantities.
36	Rate on the Intern ability to Correlate between Measured data based on the basic principles.
37	Rate on the Intern ability to Formulate the experimentation through systematic equipment and procedures.
38	Rate on the Intern ability to Formulate the mathematical modeling and simulation based on study objectives
39	Rate on the Intern ability to Analyze the data and establish correlation with defining limitations and scope.
40	Rate on the Intern ability to Represent the conclusions with the help of graphs and tabular
41	Rate on the Intern ability to Establish Pros and COns of Engineering tools for solutions
42	Rate on the Intern ability to Critique on specific Engineering tools for analysis
43	Rate on the Intern ability to Validate the tools on account of limitation, technique, resourses, accuracy and assumptions
44	Rate on the Intern ability to Inherit the protection of Public Interest on account of Health, Safety , environment, legal and cultural issues
45	Rate on the Intern Awareness about the legal laws, Standard procedures, code of conduct and Regulation on account of public interest
46	Rate on the Intern ability to Elaborate the Risk and Consequences of design solution and product
47	Rate on the Intern ability to Perceive the environmental , technical and socio-economic aspect of Sustainability
48	Rate on the Intern ability to Develop management technique and principles to nurture sustainability
49	Rate on the Intern ability to Examine the cases to propose ethical procedures with the help of Codes and standards e.g. ASME codes
50	Rate on the Intern ability to Identifiy indivisuality in Team for workload management
51	Rate on the Intern ability to Assign tasks based on well pllanned roster and data t everyone to achieve the goal
52	Rate on the Intern ability ofLeadership role to mitigate the concflict through communication
53	Rate on the Intern ability of Listening and equilites abilities
54	Rate on the Intern ability to Calmness in dificult situation.
55	Rate on the Intern ability to Demonstrate the success in team based project
56	Rate on the Intern ability to interpret the tecknical and non technical knowledge to produce the well structured documents.
57	Create schematic and well labeled diagrams and drawings for verbal and non verbal presentations through different mediums and tools
58	Rate on the Intern ability to Analyze the pros and cons of project aspects based on finance and economic theories and rules.
59	Rate on the Intern ability to of selection of optimum economic proposal based on financial aspects.
60	Rate on the Intern ability to Appraise the different project management tools to complete the engineering solutions and activities e.g. CPM and PERT
61	Rate on the Intern ability to Critique Gaps in Knowledge and Bridging it with a suitable database on a regular basis.
62	Rate on the Intern ability to Analyze the new trends in Engineering and Need analysis by carefully studying the historical advances in engineering
63	Rate on the Intern ability to perceive the credible literature review resources on account of feasibility, sustainability and Viability.

References

AICTE. (2018). Examination Reforms Policy Document. All India Council for Technical Education. https://www.aicte-india.org/sites/default/files/ExaminationReformsPolicy.pdf.

Boud, D., & Solomon, N. (Eds.). (2001). Work-based learning: A new higher education? Open University Press.

Everett, D. R. (2018). Competency-based education: An overview and roadmap for implementation. Journal of Competency-Based Education, 3(2), 5-14. https://doi.org/10.1002/cbe2.1011.

Gervais, J. (2016). The operational definition of competency-based education. Journal of Competency-Based Education, 1(2), 98-106. https://doi.org/10.1002/cbe2.1011.

Jackson, D. (2019). Developing graduate career readiness in Australia: Shifting from extra-curricular internships to work-integrated learning. International Journal of Work-Integrated Learning, 20(4), 331-344.

Karunaratne K. and Perera N. (2019). Students Perception on the Effectiveness of Industrial Internship Programme. Education Quarterly Reviews, 2 (4), 822-832. https://doi.org/10.31014/aior.1993.02.04.109

Kuh, G. D. (2008). High-impact educational practices: What they are, who has access to them, and why they matter. Association of American Colleges and Universities.

Moskal, B. M., & Leydens, J. A. (2000). Scoring rubric development: Validity and reliability. Practical Assessment, Research & Evaluation, 7(10). https://doi.org/10.7275/25rm-4w31.

Reddy, Y. M., & Andrade, H. (2010). A review of rubric use in higher education. Assessment & Evaluation in Higher Education, 35(4), 435-448. https://doi.org/10.1080/02602930902862859.

Sweitzer, H. F., & King, M. A. (2013). The successful internship: Personal, professional, and civic development in experiential learning (4th ed.). Brooks/Cole.

Tillema, H. H., Kessels, J. W. M., & Meijers, F. (2000). Competencies as building blocks for integrating assessment with instruction in vocational education: A case from the Netherlands. Assessment & Evaluation in Higher Education, 25(3), 265-278. https://doi.org/10.1080/02602930050135130