Innovation in Teaching Learning Process

Problem and Simulation Based Learning

Name of the Innovation	: Problem & Simulation Based Learning
Course Code and Name	: Introduction to Finite Element Analysis
Class and Semester	: SY & IV
Academic Year and Term	: 2023-2024 Term-II
Faculty Name and Designation	: Mr. Basithrahman A & Assistant Professor

Introduction:

The Introduction to Finite Element Analysis (FEA) course is designed to provide students with a fundamental understanding of numerical problem-solving techniques in engineering. To enhance student engagement and improve conceptual learning, Problem-Based Learning (PBL) and Simulation-Based Learning methods were integrated into the course. These approaches allow students to apply theoretical knowledge to real-world problems, improving both analytical and practical skills.

Motivation/Purpose of Innovative Technique:

Traditional lecture-based teaching often leads to passive learning, limiting students' ability to apply concepts in real-world scenarios. The motivation for implementing PBL and Simulation-Based Learning was to:

- Enhance students’ problem-solving abilities by engaging them in realistic engineering challenges.
- Improve comprehension of 1D bar, truss, and beam structures through hands-on numerical problem-solving and ANSYS simulations.
- Foster critical thinking and independent learning by encouraging students to analyze, simulate, and interpret results.
- Bridge the gap between theoretical knowledge and industry-relevant applications in aerospace engineering.
- Develop research and technical reporting skills through micro-projects on aircraft body simulations.

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Procedure Followed:

The course was structured to follow a step-by-step implementation of PBL and Simulation-Based Learning as follows:

1. Numerical Problem-Solving Approach:
   - Students were assigned problems related to 1D bar, truss, and beam structures.
   - They manually computed stress, strain, and displacement values for different loading conditions.
2. Simulation-Based Learning:
   - After solving problems analytically, students simulated the same problems using ANSYS to compare theoretical and computational results.
   - Additional simulations included:
     - Steady-State Thermal Analysis: Conduction, convection, and radiation.
     - Structural Simulations: Beam bending, hollow cantilever bracket with anti-symmetry boundary conditions, shaft in torsion, pin-supported link, slender cantilever beam, and round membrane under pressure.
3. Project-Based Learning:
   - Students conducted micro-projects on aircraft body simulations, applying their learned skills to aerospace-related components.
   - The projects required independent research, analysis, simulation, and report submission.
4. Evaluation & Assessment:
   - Students were assessed based on:
     - Accuracy of analytical problem-solving.
     - Correctness and efficiency of their ANSYS simulations.
     - Ability to interpret and validate results.
     - Quality of technical reports and presentations.

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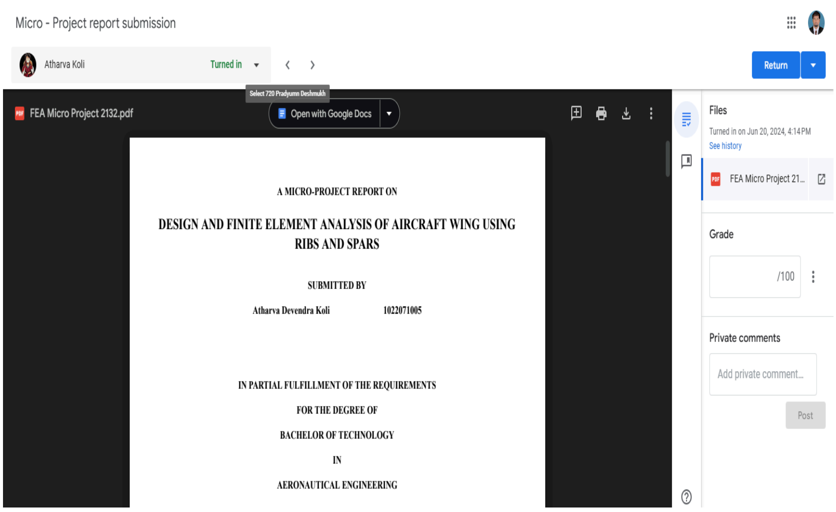
Outcome:

The implementation of PBL and Simulation-Based Learning led to several key outcomes:

- Improved Conceptual Understanding: Students developed a stronger grasp of FEA principles through problem-solving and simulations.
- Hands-on Computational Skills: Practical exposure to ANSYS helped students gain proficiency in simulation techniques.
- Bridging Theory with Application: The combination of analytical calculations and simulations reinforced students' ability to analyze real-world engineering problems.
- Enhanced Research & Communication Skills: The micro-projects encouraged students to explore aerospace applications and document findings in technical reports.
- Higher Engagement & Motivation: Active learning methods fostered critical thinking and independent exploration of FEA concepts.



References:

1. Callaghan, M. J., Harkin, J., McGinnity, M., & Maguire, L. (2007). Paradigms in Remote Experimentation. *International Journal of Online and Biomedical Engineering (iJOE)*, *3*(4).
2. Davidovitch, L., Parush, A. and Shtub, A. (2006), Simulation-based Learning in Engineering Education: Performance and Transfer in Learning Project Management. Journal of Engineering Education, 95: 289-299. https://doi.org/10.1002/j.2168-9830.2006.tb00904.x

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