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A Proposal To Integrate Interactive Simulations, Symbols & Interface Into Language & Beyond For Teaching Effectively To First-Year Engineering Students In India

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Abstract: We are experimenting with a novel approach to redefine the teaching-learning experience among undergraduate engineers. First-year engineering students will easily comprehend and have an apparent understanding of subjects taught in basic sciences in 2030. The goal is to encourage students and educators to actively participate in the teaching-learning process, thereby transforming it into an engaging and flexible learning experience. The experiment also offers great possibilities for cross-departmental research and multidisciplinary cooperation in educational institutions.
Keywords: Interactive Colours, Dynamic Visual Representations, Leaderboards & Social Sharing, AI-Powered Mentor & Streak Rewards, Real-Time Feedback, Personalized Interface & Content Recommendation, Voice-Activated Assistance & Virtual Tutor Chatbot, AI-Powered Role-Playing Games, Humanizing the Project, Pushing Innovation

INTRODUCTION

Language instruction and study have undergone several changes. Through various fields, this topic has transcended boundaries and established its existence. Throughout, the classroom teaching practices have disrupted communication trajectories. This research explores the evolution of different fields across time, the impact of technological advancements, and the ways that artificial intelligence is transforming field-based research, interpretation, and education. The implementation of visuals and animations in classroom teaching might bridge the gap between students and teachers. The research is an attempt to showcase the struggles and challenges faced by the educators' teaching students from engineering backgrounds, especially students studying in Year 1. The recent shift in teaching methods is a necessary medium to make learning more fun and interactive. The style of teaching in the classroom has undergone a revolution based on the generation's demands. We should use learning to enhance students' creativity and understanding, and to accommodate this, we need to allow minimal intervention from artificial intelligence. Various educators are currently using AI to enhance students' understanding through movement and interactivity. Due to a lack of interest, some students are not receiving complex theories, formulas, and narratives. This reduction in attention span makes it challenging for both students and teachers to achieve their goals. [1]Teaching a 17-19-year-old student is becoming challenging and difficult, practically. We conducted this research first to understand the students' psyche and bridge the significant divide that occurs in most classrooms. It's far more appropriate to say that integrating vibrant texts, symbols and characters is applicable for a certain number of subjects only; remaining subjects like Science, History & Geography, Medical & Health Sciences, Economics & Business, Language Learning and Arts & Music are dealing with real challenges on a daily basis. The analytical subject is meeting an end number of challenges regularly. We, as educators, have worked with first-year engineering students from various

backgrounds. The one thing that remains common is inquisitiveness and curiosity about self-growth. The generation accepts the power of classroom teaching but demands a newness and reformations towards the style of teaching. Believing that companies don't incorporate techniques from basic science subjects in their projects restricts students from comprehending the foundation courses.

EXISTING APPROACH

1.1 Undergraduate engineers:

India produces approximately 1.5 million engineering graduates annually. However, only about 10% are expected to secure jobs in 2024, primarily due to a significant skills gap (The Times of India, 2024) [2]. The gap is getting immensely bigger with multiple challenges, as the students are unable to grasp anything about the basics of engineering. Surveys and interviews within undergraduate engineering programmes reveal diverse perspectives on the benefits, challenges, and ethical considerations of using such technologies in academic settings (Human-Computer Interaction, Cornell University) [3]

1.2 Current Format:

Distributing laboratory reports promotes a common process to identify gaps and inculcate a clear understanding among educators and students. Traditionally, a basic rubric structures this basic report, explaining the general questions and measuring the answers on linear scales or points. Each question establishes a consistent tone or approach for answers from a biased viewpoint. The reports are measured on the basis of *Yes or No*, on which the responses recorded are meticulous but generic. Through the offline classroom interactions, the educators are focusing more on the quantity than the quality of responses. Educators asking questions with binaries is too complex in terms of answering correctly from the students' end. As Walton (2020) states, *'a student's understanding of a given problem is only as strong as her or his ability to effectively communicate that understanding*'; opting for any choice to answer is imperative for undergraduate engineers.[4] Based on all these parameters, most of the *Basic Science* courses are structured for 2-4 credits. The curriculum includes tutorials, lab experiments, assignments and lectures conducted usually in the traditional classroom setups. The lectures are conducted using PPT presentations or using a whiteboard and marker. To deliver these narratives or theories, the educators undergo a lot of learning and unlearning on a daily basis. Every day comes with new challenges, and modifications in each module are implemented before imparting to enhance better understanding. Each subject comes with its own challenges. Teaching is becoming more monotonous and repetitive from every sphere.[5]

Based on these challenges, a simplified scaffolded test run was conducted at Dayananda Sagar University, Main Campus, India, in 2024–2025 for first-year engineering students on a 2-credit professional development module. The study was an outcome of a classroom discussion conducted with a topic given to the students: *the role of gamification in the education industry'*. To address the challenges identified, language educators at Dayananda Sagar University have been actively engaging with students to gain insights into the issues that frequently arise within the classrooms. The receivers, aged 17 to 19 years, report difficulty in concentrating on the monotonous teaching style that relies heavily on theories and lectures. The outcomes of the practical experiments are also underwhelming. The majority are trying hard to comprehend the text mentioned on the screen or whiteboard because of its visual representation. The texts and visuals are simplistic and fail to engage the students. The subjects, quite seriously, are draining their attention, as the teachings provide no interactive symbols.[6][7]

The current approach does not integrate well with the simplistic texts used for classroom interaction. Today's students find it challenging to maintain their attention; however, they display a keen interest in playing games on their phones or computers. These games, characterised by vibrant simulations, symbols, and interfaces, are incredibly engaging and manage to keep students absorbed for extended periods. The discussions held with students clearly led to a coherent idea. The aim of this research is to integrate and blend interactive simulations, symbols, and interfaces with teaching, utilising Python's programming language as a bridge for effective classroom instruction. [8]

MATERIALS & METHODS

The project is developed using *Python* and aims to integrate artificial intelligence and gamification to enhance educational experiences. We subtly crafted the narrative to create something tangible, specifically

focussing on students in their 1st and 2nd semesters. The research began with note-taking and an emphasis on understanding the psyche of the students. The objective is to address the technical aspects and ensure clarity, using AI to refine and simplify the content for better comprehension.

We started the test run by asking two groups, initially consisting of approximately 40 second-semester students from all sections, for their opinions on the coursework brief. The most vocal members of each group expressed a preference for detailed, personalised feedback to enhance specific areas, suggesting that they may have been students who did not fully engage during Weeks 1 and 2 of their first year. The group's further point was more significant and warranted attention; they contended that pursuing these foundational courses was not a skill highly valued by the industry.

To begin with, we used *AI* to create a mind map that simplified ideas into more accessible concepts. We then analysed the remarks provided by the students using the mind map and identified key components for the further development of the research.[9][10][11]

An example of the codes implemented for creating the mindmap:

```
config:
  mindmap:
    maxNodeWidth: 250
  theme: mc
—
mindmap
  root((Gamification & AI<br/>in Education))
    Core Systems
      Visual Enhancements
        Color-Coding
          Constants
          Variables
          Operators
        Dynamic Visuals
          Animated Graphs
          3D Models
        Real-time Rendering
          Equation→Diagram
      AI Personalization
        Adaptive Learning
          Difficulty Scaling
          Pace Adjustment
        Real-Time Feedback
          Error Analysis
        Learning Styles
          Visual
          Auditory
    Engagement Features
      Gamification
        Reward System
        XP Points
          Badges
        Challenges
          Timed Quizzes
        Social
          Leaderboards
      Interactive Tools
        Virtual Labs
          Chemistry Sim
```

- Collaboration
  - Group Whiteboard
- Analytics
  - Student Tracking
    - Skill Heatmap
    - Time Spent
  - Teacher Dashboard
    - Class Performance
    - Intervention Alerts
- Human Elements
  - UI/UX
    - Mood Detection
    - Encouragement
  - Community
    - Study Groups
    - Q&A Forum
- Utilities
  - Time Management
    - Study Planner
    - Focus Timer
  - Customization
    - Theme Selector
    - Layout Options

Figure 1: A mind map that outlines key concepts, benefits, and applications of gamification and AI in modern education.

DISCUSSION

To address the challenges posed by mathematical equations and scientific formulas, there is no need for them to appear dull. By employing *interactive colours* for equations and making learning fun and interactive—using dynamic shades to highlight various elements, such as constants, variables, and operators—complex concepts can become easier to comprehend and visually appealing. A moving diagram is worth a thousand static ones. Animated graphs, interactive models, and real-time simulations can aid students in grasping complex theories through movement and interactivity. For instance, generating real-time diagrams for mathematical equations can improve practical understanding. Students remain motivated when they experience a clear sense of achievement. Points, badges, and unlockable content keep learners engaged and eager to progress to the next level. AI-driven difficulty adjustments guarantee that students are consistently challenged at the appropriate level, thereby minimising frustration and maximising motivation. [12]Gamify subjects like soft skills and chemistry by letting students take on roles, make choices, role-play, do more hands-on experiments in lab-based activities, and explore different outcomes in interactive, story-based learning adventures. Example: We provide a student with options to determine the story's progression based on various learning aspects. We offer students the chance to learn and unlearn the principles of chemical reactions. Subject experts get a real-time, intuitive overview of students' progress, which also helps them identify struggling students early and personalise lesson plans accordingly.[13][14] Virtual labs enable students to engage with concepts in a risk-free environment, transforming abstract ideas into tangible experiences and facilitating their understanding of the fundamentals of physics. Learning is more effective when done collaboratively. Online environments that facilitate peer-to-peer discussions, team challenges, and group projects encourage a sense of community and promote cooperative problem-solving.[15][16]A pilot is planned for 2025-26 with more than 200 students, using the students and more than 5 engineering lecturers as tutors from various courses taught to the first-year engineering students. While some lecturers are highly enthusiastic about the method, others are less so; a balanced approach is crucial to address all concerns. If the tool design proves successful, we will implement it for the entire cohort, adapting it as needed. Similarly, we plan to start the project-focused teaching format for first-year students with the arrival of freshmen next year. The tool could be advantageous for instructing the various engineering subjects included in the university's curriculum. [17][18][19][20]

CONCLUSION

A pilot will enable first-year engineering students at Dayananda Sagar University to understand and appreciate all foundational courses by projecting empathy towards the educators teaching these courses. The research will be used as a mode to assist educators in fostering deeper engagement with the course material among their students. The argument supports the need for a tool approach to enhance comprehensive skills from students' and educators' end. A proper structure and format would encourage interdisciplinary collaboration across various fields. This project aims to revolutionise education by making learning intuitive, engaging, and deeply interactive. By integrating AI-driven adaptability, gamification elements, and immersive visuals, we create a platform that is not merely a tool but an experience. [21-26]

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