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# Research on the Practical Teaching Reform of "Deep Learning and Applications" Course Supported by Generative AI Technology

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**Abstract:** With the rapid advancement of artificial intelligence, deep learning has become a core competency for students in computer science and related fields. However, the traditional practical teaching of "Deep Learning and Applications" faces significant challenges, including a steep learning curve, a notable gap between theoretical knowledge and practical application, insufficient computational resources, and a lack of personalized guidance, which collectively stifle student innovation and engagement. This paper explores a novel pedagogical reform for this course, centered on the integration of Generative AI (GenAI) technologies. We designed and implemented a new practical teaching framework that leverages GenAI as a multifaceted tool for code generation and debugging, synthetic data creation, personalized tutoring, and creative project development. Through a semester-long empirical study involving undergraduate students, we evaluated the effectiveness of this reformed curriculum. The study employed a mixed-methods approach, including pre- and post-course surveys, analysis of final project quality, and qualitative feedback. The results demonstrate that the GenAI-supported approach significantly enhances students' practical skills, deepens their conceptual understanding, and boosts their problem-solving capabilities. Specifically, students showed marked improvements in model implementation efficiency, debugging proficiency, and the ability to undertake more complex and innovative projects. The integration of GenAI not only lowered the technical barrier to entry but also fostered a more dynamic and interactive learning environment, effectively bridging the theory-practice divide. This research provides valuable insights and a replicable model for reforming advanced technology courses, highlighting the transformative potential of Generative AI in modern higher education.

**Keywords:** Generative AI; Deep Learning Education; Practical Teaching Reform; Pedagogical Innovation; Artificial intelligence in Education

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## 1.Introduction

With the advent of digital, deep learning creates surges for CV, NLP, ASMs Thus, the "deep learning and applications" course is now essential for all Computer Science, Data Science and AI majors. This course is to enable the students to understand neural network theory and how to design, implement and deploy DNN for real life problem. But the course's pedagogy lags behind the field. Traditional teaching creates a gap between abstruse math and coding application: Students run into trouble with environment set up, complex model debugging, scarce data and limited computation resources[1]. Theses difficulties decrease a student's motivation, causing them to simply mimic textbook examples rather than developing creative thinking and problem solving skills necessary for real innovation. GenAI rises and provides a unique way for education transformation. Like GPT - 4 and Stable diffusion can benefit the learning process. This paper puts forward a reform of practical teaching of "Deep Learning and Applications" course, incorporating GenAI tools to improve the learning environment. How can GenAI Copilot help students by code generating, giving feedBack, creativity possible and personal learning? We want to lessen technical hurdles for students so they can concentrate on advanced ideas and innovating, developing AI folks who are talented and creative[2]. Reformed model was introduced in this study, it's design, implementation and evaluation is provided along with an evidence of improved learning outcomes and providing a new paradigm for practical education in advance field.

## 2.Challenges in Traditional Deep Learning Pedagogy

Traditional deep learning practical teaching also brings many inherent obstacles and difficulties in student learning. A big issue is that students have a heavy cognitive load as they need to understand tricky math theories, learn Python, be good at TensorFlow or PyTorch, and grasp GPU hardware acceleration - it's a choppy learning experience. setting up a functional deep learning environment involves installing many libraries, drivers, and dependencies that can consume time and effort, before the actual learning can start And then deep learning stuff also requires a ton more coding, that's really challenging for beginner students[3]. Debugging neural networks isn't like normal software—errors are subtle and make the program fail quietly, so students have a tough time spotting problems with its architecture, hyperparameters, or preprocessed data. And it can be frustrating and helpless, especially when the instructor is late with feedback. There's another big problem: the "dataset dilemma." High-performers in DL need big, well-formatted datasets, which can be tough for students who have privacy, storage, or collection problems. Standard datasets like MNIST or CIFAR-10, though good for novices, lack actual world complexity, making projects less relevant and skills harder to transfer to real industry problems. The "one size fits all" model stifles creativity and dismisses different student interests. If we give all the students the same project then there is a chance which can lead to rote learning and plagiarism and will be less scope for the individual student to explore the niche area which might interest them. This kind of standardization fails to raise the innovative mindset and adaptability needed for AI jobs.

## 3.The Role of Generative AI in Reshaping Practical Teaching

The integration of Generative AI into the "Deep Learning and Applications" curriculum offers a powerful antidote to the challenges plaguing traditional pedagogy. GenAI can be strategically employed as a versatile educational tool that redefines the student learning experience by providing scaffolding, personalization, and creative empowerment. Firstly, GenAI, particularly large language models (LLMs), can serve as intelligent coding assistants. Students can use these tools to generate boilerplate code for data loading, model architecture, and training loops, which dramatically lowers the initial barrier to entry and accelerates the development process. Instead of getting bogged down by syntax and library-specific implementation details, students can focus their cognitive energy on understanding the core logic and high-level design of their models. When encountering bugs, they can leverage AI to explain error messages, suggest potential fixes, and refactor code for better clarity and efficiency. This transforms the frustrating process of debugging into a valuable, interactive learning opportunity. Secondly, GenAI provides a solution to the dataset scarcity problem[4]. Generative models like Generative Adversarial Networks or Variational Autoencoders can be used to create high-quality synthetic data. This not only provides students with ample data for training their models but also serves as a practical learning module in itself, allowing them to explore concepts of data distribution. Students can learn to generate custom datasets tailored to specific, imaginative project ideas, freeing them from the constraints of pre-existing, and often overused, public datasets[5]. The comparison outlined in Table 1 highlights the transformative shift from a static, resource-limited model to a dynamic, AI-augmented one.

*Table 1: Comparison of Traditional vs. Generative AI-Supported Practical Tasks*

| Feature Area | Traditional Practical Task | Generative AI-Supported Practical Task |
|---|---|---|
| Project Scaffolding | Manual code writing from scratch; high initial friction. | AI-assisted code generation; rapid prototyping and iteration. |

| Feature Area | Traditional Practical Task | Generative AI-Supported Practical Task |
|---|---|---|
| Dataset Availability | Limited to standard, pre-existing academic datasets. | Ability to generate custom, diverse synthetic datasets on-demand. |
| Code Debugging | Time-consuming, reliant on instructor or peer support. | Instant, interactive AI-powered explanations and suggestions. |
| Personalized Feedback | Delayed and generalized feedback from instructors. | Real-time, context-specific tutoring and conceptual clarification. |
| Project Innovation | Constrained by technical complexity and available resources. | Enabled by AI tools to explore more creative and ambitious ideas. |
| Learning Curve | Steep and often frustrating for novice learners. | Smoothed by AI assistance, allowing focus on higher-level concepts. |

This table clearly illustrates how GenAI acts as a catalyst, transforming previously challenging aspects of the learning process into opportunities for deeper engagement and understanding. It shifts the instructor's role from a primary troubleshooter to a facilitator of higher-order thinking, guiding students as they use AI tools to explore more ambitious and personalized projects. By automating mundane tasks and providing on-demand support, GenAI empowers students to become more autonomous and confident learners, capable of tackling complex problems with a blend of theoretical knowledge and advanced practical skills. This new paradigm fosters an environment where curiosity and creativity are not just encouraged but are actively supported by powerful technological aids[6].

## 4.Design and Implementation of the Reformed Curriculum

Based on the potential of Generative AI to mitigate the challenges of traditional pedagogy, we designed and implemented a reformed practical curriculum for the "Deep Learning and Applications" course. The central principle of this reform was to embed GenAI tools seamlessly into the existing learning structure, not as a replacement for fundamental understanding, but as a powerful enabler of it[7]. The implementation was rolled out over a 16-week semester for a cohort of 85 undergraduate students. The curriculum was redesigned into a series of project-based modules, each tackling a core area of deep learning while integrating specific GenAI applications. For the foundational modules on topics like Convolutional Neural Networks and Recurrent Neural Networks , students were introduced to AI-powered coding assistants such as GitHub Copilot. They were trained not just on how to use these tools to generate code, but more importantly, on how to critically evaluate, debug, and refine the AI-generated outputs. This approach aimed to develop their skills in prompt engineering and AI-assisted problem-solving. For more advanced modules, the integration of GenAI became more profound. For instance, in the module on image processing, instead of merely using standard datasets, students were tasked with using text-to-image models like Stable Diffusion to generate a unique dataset of images based on a creative theme[8]. They then had to train a CNN model to classify these AI-generated images, providing them with an end-to-end understanding of both generative and discriminative models. The detailed structure of this reformed curriculum is presented in Table 2.

*Table 2: Structure of the Reformed 'Deep Learning and Applications' Curriculum*

| Module No. | Topic | Learning Objectives | Practical Activity with GenAI Integration | GenAI Tools Used |
|---|---|---|---|---|
| 1-3 | Foundations & Neural Networks | Understand basics, build simple networks. | Use AI assistant to generate boilerplate code for data loading and model layers; debug syntax errors. | GPT-4 (via API), GitHub Copilot |
| 4-6 | Convolutional Neural Networks (CNNs) | Master CNNs for image classification. | Generate a custom synthetic image dataset using a text-to-image model; train a classifier on this data. | Stable Diffusion, Midjourney |
| 7-9 | Recurrent Neural Networks (RNNs) & NLP | Understand sequence modeling for text. | Use an LLM to generate diverse text prompts; build an RNN-based sentiment analyzer for the generated text. | GPT-4 API |

| Module No. | Topic | Learning Objectives | Practical Activity with GenAI Integration | GenAI Tools Used |
|---|---|---|---|---|
| 10-12 | Generative Adversarial Networks (GANs) | Grasp the theory and application of GANs. | Fine-tune a pre-trained GAN model on a specific domain; analyze and critique the quality of generated outputs. | PyTorch, Pre-trained StyleGAN models |
| 13-16 | Final Capstone Project | Synthesize knowledge to solve a complex problem. | Propose and develop a novel application leveraging one or more GenAI technologies. | Student's choice of relevant AI tools and APIs |

This modular structure ensured a progressive learning journey. Early modules focused on using GenAI for assistance and efficiency, gradually transitioning to more advanced modules where GenAI itself was the subject of study and the core component of the project. The final capstone project provided students with the ultimate freedom to explore their interests, challenging them to develop a novel application that showcased their mastery of both deep learning principles and GenAI tools. Throughout the semester, traditional lectures were supplemented with hands-on workshops focused on the ethical use of AI, prompt engineering techniques, and the critical assessment of AI-generated content. This holistic approach ensured that students developed not only technical proficiency but also a responsible and informed perspective on the capabilities and limitations of generative AI, preparing them to be conscientious innovators in the field.

## 5.Evaluation of Teaching Outcomes

To quantitatively and qualitatively assess the effectiveness of the generative AI-integrated teaching reform, we conducted a comprehensive evaluation throughout the semester. The methodology involved a multi-faceted approach, including pre- and post-course surveys based on a 5-point Likert scale to measure students' self-assessed skills and confidence, a detailed analysis and comparison of the final capstone projects against those from a previous cohort taught using traditional methods, and the collection of anecdotal feedback through focus group discussions. The pre-course survey established a baseline, confirming that most students entered the course with a theoretical understanding of AI but limited practical experience and low confidence in their ability to build and debug complex models. The post-course survey results, as summarized in Table 3, revealed a statistically significant improvement across all measured skill dimensions. Students reported a substantial increase in their confidence and efficiency in implementing models, debugging code, and creatively applying deep learning concepts to novel problems[9]. The most notable improvements were observed in "Creative Problem-Solving" and "Project Implementation Speed," which directly correlate with the affordances of the GenAI tools that students used to brainstorm ideas and accelerate their development workflows.

*Table 3: Pre- and Post-Reform Student Skill Self-Assessment (Scale 1-5, n=85)*

| Skill Dimension | Pre-Reform Mean Score | Post-Reform Mean Score | Percentage Change |
|---|---|---|---|
| Conceptual Understanding | 3.1 | 4.6 | +48.4% |
| Model Implementation Proficiency | 2.2 | 4.4 | +100.0% |
| Code Debugging Efficiency | 1.9 | 4.1 | +115.8% |
| Creative Problem-Solving | 2.5 | 4.7 | +88.0% |
| Project Implementation Speed | 2.1 | 4.5 | +114.3% |

The second source of empirical data was from comparing capstone projects. The projects in the experimental group where assessed by instructors on a rubric that evaluated how much technical depth was put into it, was it innovative and complex? In Table 4 it can be seen that the reformed curriculum has gotten the highest scores for every category especially for innovation: Traditional curriculum projects were commonly made with a standard implementation on a common dataset, but genai supported projects showed incredible creativity and ambition [10]. The examples comprised apps employing an LLM to create animation scripts and systems for synthetic medical images augmentation which adds to the training data of medical disease detection systems. They were a bit more technologically advanced and they dived into the world of what the real world impact of AI was. In terms of students' focus group feedback, they agreed with these statements, as well as stating that AI tools made it feel like they really were a developer, able to mess around and try things, making for a good learning experience.

*Table 4: Analysis of Final Project Complexity and Innovation Scores (out of 10)*

| Evaluation Metric | Control Group (Traditional, n=78) | Experimental Group (GenAI-Reformed, n=85) | Improvement |
|---|---|---|---|
| Technical Depth | 6.2 | 8.5 | +37.1% |
| Innovation & Creativity | 4.5 | 8.9 | +97.8% |
| Project Complexity | 5.8 | 8.2 | +41.4% |
| Overall Score | 5.5 | 8.5 | +54.5% |

## 6.Conclusion

This research has systematically investigated the integration of Generative AI as a transformative tool in the practical teaching reform of the "Deep Learning and Applications" course. The findings unequivocally demonstrate that this novel pedagogical approach yields substantial benefits, effectively addressing the persistent challenges of traditional methods. By leveraging GenAI for code generation, synthetic data creation, and personalized support, we have successfully lowered the steep technical barriers that often discourage students, allowing them to engage more deeply with core conceptual material. The empirical results, drawn from student self-assessments and expert evaluation of capstone projects, provide compelling evidence of improved learning outcomes. Students in the reformed curriculum not only achieved greater technical proficiency and debugging efficiency but also demonstrated a remarkable enhancement in their capacity for creative problem-solving and innovation. The freedom to rapidly prototype ideas and explore more ambitious projects fostered a more dynamic, engaging, and motivating learning environment, effectively bridging the gap between abstract theory and practical, real-world application. However, the successful implementation of such a curriculum is not without its challenges. It requires a pedagogical shift where instructors evolve into facilitators who guide students in the critical and ethical use of AI tools, rather than simply transmitting information. There is a tangible risk that students might develop an over-reliance on AI, potentially neglecting the development of fundamental coding skills. Therefore, future iterations of the curriculum must place an even stronger emphasis on teaching students to critically analyze, validate, and refine AI-generated outputs, ensuring that these tools serve as a scaffold for learning, not a crutch. Furthermore, the ethical dimensions of generative AI, including issues of bias, plagiarism, and misinformation, must be woven deeply into the educational fabric. Future research should explore the long-term impact of this pedagogical model on student career trajectories and investigate its applicability across other complex STEM disciplines. In conclusion, the strategic integration of Generative AI in deep learning education represents a significant step forward, promising to cultivate a new generation of AI professionals who are not only technically adept but also creatively agile and ethically conscious.

## Funding

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## Conflict of Interests

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