LEVERAGING GENERATIVE AI IN PROJECT-BASED LEARNING TO DEVELOP A FASHION RETAIL CHATBOT: LECTURERS' PERSPECTIVES

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Project-Based Learning (PjBL) is an instructional strategy practiced in Republic Polytechnic (RP) due to its learner-centred approach, which is grounded in research and practice-based principles of effective teaching and learning. This pedagogical approach equips students with the intellectual and practical skills necessary to solve real-world problems. By engaging students in authentic industry projects, PjBL offers immersive experiences that integrate industry collaboration and peer learning among student teams. One example from the School of Infocomm (SOI) in RP is our collaboration with Decks Private Limited, where students worked on a Final Year Project (FYP) to develop a conversational chatbot for the fashion retailer chains. The scope of the FYP aimed to address customer service challenges by leveraging AI technologies to enhance customer engagement and improve operational efficiency. Lecturers encourage students to use Generative AI (GenAI) and Large Language Models (LLMs), such as ChatGPT, GitHub Copilot, and DALL-E 3, as teaching and learning tools to create innovative solutions. The integration of these tools enabled students to experience the full scope of the AI development process, including data collection, model training, code testing, deployment, and performance evaluation. In our PjBL approach, lecturers encouraged students to explore and harness knowledge and technical know-how through the use of LLMs during their project engagement. Beyond technical skills, the project emphasised the importance of ethical AI development, focusing on mitigating risks such as AI hallucinations and ensuring data privacy and security. Through this hands-on experience, students gained valuable insights into the challenges and opportunities associated with emerging GenAI technologies. Collaborative learning among peers and engagement with industry partners enriched the learning process, fostering critical thinking, creativity, and problem-solving skills. While PjBL offered notable benefits, this paper also discussed the key challenges associated with its implementation from the lecturers' perspectives. The outcomes of this FYP demonstrated the effectiveness of PjBL in preparing students for the demands of the modern workforce. By applying theoretical knowledge in a real-world context, students developed not only technical expertise but also essential soft skills such as communication, teamwork, and adaptability. This comprehensive learning approach ensures that RP graduates were well-prepared to make meaningful contributions to the industry.

Keywords: *project-based learning, generative artificial intelligence*

Introduction

Project-Based Learning (PjBL) is a widely used instructional strategy at Republic Polytechnic (RP), offering students an opportunity to explore topics in depth through complex projects. These projects incorporate key learning challenges, where students apply their knowledge and skills to create meaningful deliverables. With adequate resources and time, students can produce high-quality projects that showcase their expertise.

PjBL is ideal for blending theory and practice to address complex problems, promoting deep exploration and producing well-crafted outcomes (Larmer et al., 2015; Blumenfeld et al., 1991). In this pedagogy, lecturers serve as facilitators and supervisors, guiding students through their projects and ensuring high-quality results. They may collaborate with community or industry partners to co-develop solutions, adding real-world relevance to the projects.

According to Almulla (2020), critics of PjBL often raise concerns that the focus on completing a project might overshadow the actual learning process. This paper presents two lecturers' perspectives on the effectiveness of PjBL in engaging students in authentic learning through the development of a fashion retail chatbot by RP's School of Infocomm (SOI) students, as part of their Final Year project (FYP).

Overview of Project-Based Learning

An instructional strategy guides the design and delivery of curricula in higher education institutions (IHLs). At Republic Polytechnic (RP), Problem-Based Learning (PBL) is the primary pedagogy for most diploma programmes, with three other instructional

strategies identified for their learner-centred approach: Project-Based Learning (PjBL), Cognitive Apprenticeship (CA), and Interactive Seminar (IS).

PjBL enables students to actively gain knowledge and skills by working on extended projects that involve investigating and responding to real-world problems. It fosters active learning, critical thinking, and collaboration, centred around exploring and investigating complex challenges. Lecturers function as facilitators and supervisors, ensuring students stay on track and produce high-quality outcomes. They may also collaborate with external stakeholders to co-develop solutions, bringing practical, real-world impact.

Gonzalez (2016) states that PjBL engages and inspires students by incorporating projects at the outset of their learning journey. By involving students in authentic problems, PjBL connects learning to real-world applications, making it more meaningful and practical. As a result, students take an active role in their learning, enhancing knowledge retention and developing key skills such as time management, teamwork, and task delegation.

Since PjBL has been posited as a powerful tool for nurturing student creativity and is adaptable to various learning preferences and styles (Yu, 2024), this approach could also foster creativity by encouraging original thinking and innovative solutions (Zhang et al., 2023).

Background of AI Chatbots

ELIZA was one of the first chatbots developed in 1966. It used pattern-matching techniques to generate automated responses (Lane et al., 2025). Aiming to improve conversational depth, PARRY was developed half a decade later to simulate a patient with paranoid schizophrenia (Jeevanandam, 2024). In 2016, Amazon conducted an international university competition called the AWS Chatbot Challenge[1], focused on building a socialbot. The chatbots created were capable of conversing with humans on popular topics, ranging from entertainment and fashion to politics, sports, science, and technology. With the advancements in Natural Language Processing (NLP), Deep Learning, transformers, and Large Language Models (LLMs) in recent years, AI chatbots have become more context-aware and capable of providing human-like conversations.

Roles of Chatbots for Online Fashion Retailing

In today's virtual customer service environment, online retail companies are expected to offer 24/7 on-demand support. Customers now seek instant answers, rather than waiting for a response from a representative. Gartner[2] forecasts that by 2027, chatbots will become the primary customer service channel. Chatbots not only automate customer support but also help with tasks like collecting user information, organising meetings, and reducing operational costs. Their ability to handle multiple customer requests simultaneously and respond quickly has led to their rapid growth. According to a 2017 study[3], key reasons people prefer chatbots include productivity, curiosity, and social interaction. Powered by generative AI, modern chatbots offer dynamic responses, making them increasingly prevalent in customer service.

Applying PjBL Methodology in Final Year Projects

The purpose of a Final Year Project (FYP) is to provide our final year students with a hands-on, practical experience that integrates and applies the knowledge and skills they have acquired throughout their course of study. At RP, the FYP typically spans one semester, lasting around 16 weeks. It is undertaken in the final year of a diploma programme, often in conjunction with an industry internship.

PjBL is highly suitable for FYPs because it provides a hands-on approach, enabling students to apply their knowledge in real-world contexts. Developing an online retail chatbot was a clearly defined problem for FYP students. Not only were the challenges complex and open-ended, but they also demanded critical thinking, strong problem-solving skills, and innovation, which are core elements of PjBL. This approach also fostered collaboration, teamwork, and communication, mirroring real-world professional environments. By partnering with industry, PjBL provided students with practical experience and exposure to current software practices, while enhancing self-management and project management skills. Moreover, the tangible outcomes of PjBL-based FYPs, such as prototypes and solutioning, helped students build strong portfolios, improving their employability and industry readiness.

Before attaining the learning outcomes from PjBL, it is essential to first define clear and measurable outcomes that focus on specific skills, knowledge, and real-world ICT applications. Nevertheless, projects should be structured around authentic, real-world challenges that encourage critical thinking, creativity, and collaboration. Active participation is crucial as it grants students the opportunity to take ownership of their learning through group discussions, brainstorming, and peer feedback. Lecturers functioned as facilitators rather than traditional teachers, guiding students with open-ended questions and providing necessary resources while promoting self-directed learning through problem-solving. Reflection and feedback also played a vital role (Thomas, 2020; Guo et al., 2020), as regular reflections helped students evaluate their progress in software development and identify areas for improvement.

Generative AI for Teaching and Learning

[1] AWS Chatbot Challenge, https://awschatbot2017.devpost.com/

[2] https://www.gartner.com/en/newsroom/press-releases/2022-07-27-gartner-predicts-chatbots-will-become-a-primary-customer-service-channel-within-five-years

[3] https://vdoc.pub/documents/internet-science-4th-international-conference-insci-2017-thessaloniki-greece-november-22-24-2017-proceedings-14epiogqcih8

There is no specific module in SOI that teaches niche topics such as virtual assistants or chatbot development, let alone the ideal Large Language Models (LLMs) to be selected for responding effectively to users' enquiries and providing decision-making support and appropriate fashion recommendations. Therefore, our FYP students had to conduct exploration and investigation into the problem, which typically included literature reviews, data collection, and analysis before starting their project development. Students leveraged Generative AI (GenAI) tools through PjBL in identifying relevant LLMs, prototyping solutions, and refining their chatbot applications. By using GenAI tools, students were able to simulate various chatbot responses, evaluate performance, and optimise user interactions in real time.

Project Execution

In this industry FYP, we partnered with Decks Pte Ltd, one of the leading apparel suppliers for department stores in Singapore, to develop a conversational chatbot for fashion retail through FYPs. Through an industry partnership with Decks, FYP students from SOI designed and developed a fashion retail chatbot featuring an automated system that communicated with humans via text or voice messages. It was envisioned as a virtual customer service companion integrated into a Shopify website to help the company connect more closely with its customers.

FYP execution focuses on students carrying out their planned research and development work to achieve the project's objectives. Throughout the semester, students used their technical and analytical skills to design solutions, perform testing, and develop prototypes. The following is the sequence of AI tools utilised during project execution:

1. Text and Content Generation
2. Code Generation
3. Image Generation

Text and Content Generation

During the first two weeks of the FYP, our students leveraged GenAI for brainstorming and literature review. Tools such as ChatGPT[4], Gemini[5], Claude[6], Perplexity[7], and DeepSeek[8] are AI-powered answer engines that generated text content based on patterns learned from data. These tools are powered by LLMs, enabling them to produce human-like responses, making them highly effective for tasks such as text and content generation through a sophisticated process of analysing and predicting patterns in natural language.

Throughout project development, students utilised LLMs as both a learning tool and a development resource to guide them in building their chatbot. As a learning tool, it helped students grasp natural language processing (NLP) concepts and provided real-time assistance in generating conversational responses. Through prompt engineering, students were able to experiment with designing chatbot dialogue flows, refining input prompts, and optimising responses for relevance and clarity (see Figure 1). As a development resource, LLMs are used for simulating chatbots for customer support, allowing students to test and improve their projects iteratively. In addition, these models provided instant feedback, helping students debug software issues and improve chatbot performance more efficiently.

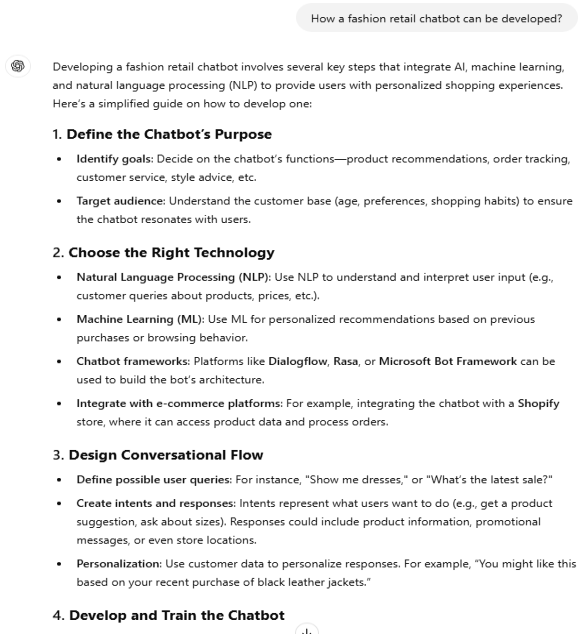

Figure 1. An example of an enquiry for information on chatbot development using ChatGPT.

Code Generation

During the project development phase, students explored GitHub Copilot to generate programming code for chatbot testing and performance measurements, as shown in Figure 2. This GenAI tool was powered by OpenAI's *Codex*, which is an LLM trained on a wide range of programming languages, including Python, Java, and C++. *Copilot* suggested code snippets, generated functions, and even assisted the students with specific tasks based on the comments or prompts they had provided in their code editor, such as Visual Studio Code.

CoPilot assisted our students in writing functions or classes, provided code suggestions, and helped with their debugging and refactoring. For more advanced types of chatbot testing, students used automated test libraries, such as *pytest* or *Selenium*, to evaluate the chatbot user interfaces (UIs). For performance testing, students simulated multiple users interacting with the chatbot using load testing tools like *JMeter*.

Although Copilot is a powerful GenAI tool for IT students, it comes with several limitations. For instance,

[4] https://chatgpt.com/
[5] https://gemini.google.com/
[6] https://claude.ai/
[7] https://www.perplexity. ai/
[8] https://chat.deepseek.com/

it can generate inaccurate or low-quality code due to its lack of full contextual understanding. Conspicuously, the output generated may contain inconsistencies in coding style or conventions. Since the AI models depend on public code data, it can result in suboptimal solutions for niche problems. Most importantly, there are risks of security vulnerabilities or licensing concerns due to the potential for suggesting copyrighted code.

```python
# chatbot.py
def chatbot_response(user_input):
    responses = {
        "hello": "Hi there!",
        "how are you": "I'm doing well, thank you!",
        "bye": "Goodbye! See you soon."
    }
    return responses.get(user_input.lower(), "Sorry, I didn't understand that.")
```

Testing the Chatbot

```python
import unittest
from chatbot import chatbot_response

class TestChatbot(unittest.TestCase):

    def test_greeting(self):
        response = chatbot_response("hello")
        self.assertEqual(response, "Hi there!")

    def test_how_are_you(self):
        response = chatbot_response("how are you")
        self.assertEqual(response, "I'm doing well, thank you!")

    def test_bye(self):
        response = chatbot_response("bye")
        self.assertEqual(response, "Goodbye! See you soon.")

    def test_unknown(self):
        response = chatbot_response("random text")
        self.assertEqual(response, "Sorry, I didn't understand that.")

if __name__ == '__main__':
    unittest.main()
```

Figure 2. An example of using GitHub Copilot as a code assistance tool to generate a Python programming script for testing chatbot.

Copilot is more suitable for common coding tasks but may not manage complex or novel problems well. Therefore, students who over-rely on it may hinder their learning. Additionally, it lacks debugging and testing features and may cause performance issues in large codebases. Despite these drawbacks, it remains useful for students to streamline routine tasks, but it should be used critically alongside manual code reviews by peers and FYP supervisors.

Image Generation

Along with matching prompts from text generation, students also used GenAI tools, such as Midjourney[9], MaxAI[10], OpenArt[11], or Image Creator in Bing[12] to generate a set of images and graphics for use in their FYP report (see figure 3). The purpose of an GenAI image creator in GenAI is to automatically generate realistic or stylised images based on user input. These tools play a vital role in creative content generation, helping designers, marketers, and visual content creators to produce unique visuals for advertising, social media, and storytelling.

GenAI tools enhance education, training, design, and research by developing graphical concepts, visualising complex ideas, and generating assets rapidly for entertainment and gaming. They support students' research by producing synthetic data for AI training, making high-quality visuals accessible to students, promoting inclusivity, and reducing the need for advanced skills or resources.

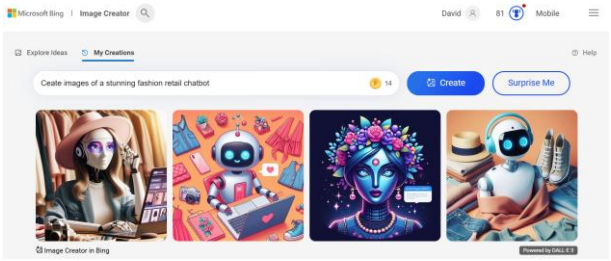

Figure 3. Examples of AI images generated using DALL-E 3.

However, the use of GenAI image generators came with several challenges. One key issue was the quality and accuracy of the generated images, which may have had flaws such as distorted features or mismatched proportions. Bias and underrepresentation in training data could also have led to stereotypical or unbalanced content, raising concerns about fair representation.

Moreover, ethical and copyright issues are significant, as it is often unclear whether the AI-generated images infringe on copyrighted material. Furthermore, these tools can be misused to create misleading content, such as deepfakes, which contribute to misinformation and deception.

While AI could generate visually impressive content, it lacked true creativity and struggled to understand abstract concepts and complex cultures. Computational cost was another challenge, as generating high-quality images required substantial processing power, which was costly and resource intensive.

Finally, students could risk becoming overly reliant on AI, potentially stifling human creativity, and diminishing the emphasis on developing their creative skills.

Responsible AI Implementation

When using LLMs, it is crucial to consider both ethical and safety aspects. Ethically, LLMs could reflect biases present in the training data, leading to unfair or discriminatory outputs. Therefore, issues such as privacy, data security, and the potential generation of misinformation or copyrighted content must be addressed. The responsible usage of GenAI tools involves verifying outputs and protecting sensitive information. There are also societal concerns, such as

[9] https://www.midjourney.com/
[10] https://www.maxai.co/ai-tools/ai-art/
[11] https://openart.ai/
[12] https://www.bing.com/images/create

user dependency, which could be mitigated through education and human oversight (Yan et al., 2023).

From a safety perspective, LLMs could have generated harmful or offensive content and could have been exploited for malicious purposes, such as phishing or spreading fake news. Autonomous systems, such as AI chatbots that relied on LLMs to generate text outputs, posed risks of physical harm if errors occurred, necessitating rigorous testing and safety protocols (Ayyamperumal & Ge, 2024).

Furthermore, Ahmad (2024) highlighted the importance of human-centricity and proposed that chatbot owners should offer clear channels for feedback. He emphasised the need for an escalation of incidents when necessary. Balancing these considerations could ensure that LLMs are used responsibly, leading to a positive impact.

LLM such as *ChatGPT* is a valuable tool for students to explore and experiment with chatbot development, allowing them to better understand natural language processing, enhance their coding skills, and create innovative solutions. Nevertheless, it was essential that students remained mindful of ethical considerations and responsible AI practices throughout the development process.

To prevent over-reliance on Generative AI (GenAI), supervisors implemented safeguards such as weekly progress checkpoints, project presentations, and Q&A sessions to assess students' understanding and originality. Clear guidelines on AI usage were established, and students were required to acknowledge AI assistance in their reports. Additional measures, including collaborative development, supervisor reviews, code walkthroughs, and AI detection tools like Measure of Software Similarity (MOSS) and Turnitin[13], ensured authenticity in project work.

Results and Discussion

The PjBL approach in this study was found to enhance student learning by offering hands-on, real-world experiences that made concepts meaningful. It promoted active engagement, critical thinking, and problem-solving, while also fostering essential skills such as teamwork, communication, and creativity. Authentic assessments allowed them to demonstrate their knowledge through practical software applications they developed.

Four teams of final-year SOI students, supervised by two lecturers, developed the fashion retail chatbot over the course of one semester. The perspective shared by the two lecturers highlighted how this industry project motivated students to enhance their technical competencies using GenAI technologies while applying project management skills across various stages of the software development lifecycle (SDLC). Students carried out code validation and chatbot testing using LLMs, gaining exposure to industry practices and new innovations from their unique perspectives.

While PjBL offered significant benefits, it also presented challenges. Not all students possessed the same level of self-management or collaboration skills at the start, which could lead to imbalances in group dynamics. Some dominated certain tasks, while others struggled with independence or staying on track. Ensuring consistent quality across project teams was also difficult. Certain projects appeared polished but lacked depth, while others reflected deep understanding but fell short in presentation.

Another significant hurdle students encountered during PjBL was the limited availability of resources such as time, materials, information, and expertise. These resources were essential for completing the project, but they were not always readily available or accessible to all students. This restricted their creativity, inquiry, and problem-solving abilities. To address this, lecturers provided adequate and appropriate resources or guided students in finding and evaluating them. They also supported students in prioritising tasks, managing time effectively, and seeking assistance when needed.

A further challenge involved managing the limitations of LLMs, particularly the issue of hallucination, where outputs could be inaccurate or unsubstantiated. Hallucination occurred due to factors such as gaps in training data, biases, or vague prompts, resulting in convincing yet factually inaccurate outputs. To mitigate these risks, students were encouraged to fact-check responses using reliable sources and provide clear, detailed prompts during queries.

Lecturers also played a critical role in guiding students to use GenAI tools, such as ChatGPT and Claude, responsibly. The widespread adoption of LLMs led students to ask them questions, expecting factual answers. While GenAI models could answer some questions correctly, they also confidently provided many incorrect answers. For more accurate results, integrating external knowledge bases through retrieval-augmented generation (RAG) and domain-specific fine-tuning can enhance reliability and reduce errors. Close supervision and structured support for semantic searches are crucial when students undertake high-stakes tasks.

Conclusion

PjBL is a powerful pedagogical approach that provides students with real-world experience. Integrating GenAI technologies in Final Year Projects (FYPs) not only helped students enhance their technical skills but also enabled them to develop essential soft skills such as teamwork, communication, and project management.

The successful development of an online fashion retail chatbot highlighted the potential of PjBL to create meaningful learning experiences. However, challenges such as skill disparities and varying project quality had to be addressed through targeted support, structured guidance, and continuous improvement of the PjBL framework.

[13] https://justdone.ai/

Moving forward, incorporating more industry collaborations, and leveraging advanced GenAI tools will further enhance the effectiveness of PjBL and better prepare students to thrive in an increasingly technology-driven world. RP remains committed to engaging students in authentic industry projects, ensuring they acquire the intellectual and practical skills necessary to tackle real-world challenges. We are confident that these experiences will enable our students to make meaningful contributions to the industry.

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