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A PDCA Framework for Solving Analytics Problems Using Generative AI

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ABSTRACT

Generative AI, more specifically Large Language Models, are becoming pertinent to develop computer codes for various applications. An iterative method built on the Plan-Do-Check-Act framework is proposed to develop Python code for the descriptive and predictive analysis of a simple yet realistic data set. The example shows how ChatGPT can be used by inexperienced students to write sufficiently detailed Python code for data analytics. The example also shows that while sufficiently good analysis and interpretable code may emerge from iteratively improving LLM prompts, to achieve more complete and correct analysis the expertise of LLM users still remain essential.

KEYWORDS: Data analytics, Iterative method, Coding, Large Language Models

INTRODUCTION

Automating coding tasks has been an ambitious goal in artificial intelligence (AI) and computer science (CS). Unexpectedly rapid improvements in generative AI and large language models (LLMs) have resulted in the proliferation of tools to achieve this goal. Parallel to this development, studying the habits of how coders use these new tools to perform their tasks reliably is an emerging area for research. In this paper I describe a methodology to utilize LLMs to develop code in the data analytics / machine learning domain. The context of the recommended method is the task of writing Python code with commonly available packages for data analytics. The Plan-Do-Check-Act (PDCA) iterative framework (Moen & Norman, 2009) is adapted to achieve a systematic way to improve the analysis of a data set. It is necessary to use an iterative method to develop data analytics code as LLMs presently cannot be relied on generating reliable and interpretable code. Often there are unverified assumptions, incorrect algorithms and parameter settings, and other manifestations of 'hallucinations' in the code suggestions of LLMs. For this paper the canonical Palmer Penguins dataset was chosen as an example as it is simple yet not 'perfect'. The setting in which this iterative data analytics code development is placed assumes that the student is familiar with basic Python coding, concepts and principles of data analytics and machine learning, and can write prompts for LLMs. ChatGPT 3.5 (OpenAI, 2023) is used as it is the most well-known LLM, it is free to use, and among the freely available LLMs it shows some of the best performance metrics. Since ChatGPT is not capable of running code, the Python code returned is copied into a Jupyter Notebook and executed there (Kluyver et al., 2016). To demonstrate both the capabilities and shortcomings of ChatGPT recommended code snippets, simple prompts are shown.

LITERATURE REVIEW

Large language models can provide code snippets and/or complex functions to develop a multitude of applications. They can translate English language description into programming languages, help novice programmers to write code, and improve experienced programmers'

productivity, However, the resulting code is often incorrect, not efficient, or not easy to understand.

Large Language Models

LLMs have greatly evolved since the publishing of the basic ideas of transformers operating on tokenized input data (Vaswani et al., 2017). They are a subcategory of generative AI systems that can generate textual outputs using multiple tens of billions of parameters that had been trained on expansive corpora as training sets (Brown et al., 2020). An important direction of development is focusing on LLMs ability to generate computer code that solves problems with previously unseen specifications (Chen et al., 2021). These language models are becoming more and more efficient in generating code in different programming languages, specifically in the Python programming language which is very broadly used in data analytics.

The PDCA Framework: The Iterative Development Method

The PDCA framework (Moen & Norman, 2009), also known as the Deming Cycle or Deming Wheel, was introduced by W. Edwards Deming in Japan during the 1950s (Deming, 1986). It embodies a systematic approach to process improvement, emphasizing four key stages:

1. Plan: In this initial phase the process goals are set along with enumerating assumptions, early changes and actions to achieve the process goals.
2. Do: In this step the plan implementation takes place
3. Check: This is the critical evaluation phase on how the results from the 'Do' phase perform towards achieving the main goal.
4. Act: Based on the evaluation from step 3, improvement actions are executed in this step. If not all goals and metrics are satisfied, we can iterate back to the Planning phase at this point.

The Data Set

To demonstrate the use of the PDCA iterative framework for solving a data analytics problem with LLM generated Python code, the well-known Palmer Penguin data set was selected (Horst et al., 2022). There are several reasons why this data set was chosen. While it is relatively simple and small, it is not as perfectly clean as the canonical Anderson Iris data set (Anderson, 1935) popularized by Fisher (1936). It has 3 categories that are not perfectly balanced, 7 variables potentially usable for data analytics, and few missing variables. These features make this data set very useful to teach basic data analytics skills and consequently to build and evaluate data analytic Python code 'recommended' by an LLM.

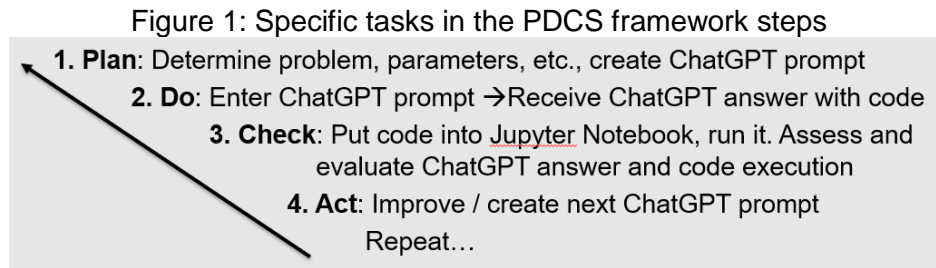
ITERATIVE CODE DEVELOPMENT USING THE PDCA FRAMEWORK

Following the principles of the PDCA process, the four steps can be reframed the following way for the specific case of generating Python code for analyzing a data set:

1. Plan: For the Python code development, this phase involves defining the problem, selecting appropriate algorithms (such as clustering and decision trees), outlining our approach, and generating the starting LLM prompt.
2. Do: In this step the LLM is prompted to output a Python code. The language model will generate code snippets, comments, entire functions, and under ideal conditions possibly a complete code for the analysis.

3. **Check:** In this evaluation phase, first the LLM generated code is run in a Python environment. The code is assessed for syntactical and semantic correctness. The outputs of the code is also assessed for correctness and the performance of the code is evaluated against the expectations. Code quality, readability, algorithm selection, implementation, and result evaluations are reviewed.
4. **Act:** Based on the evaluation from step 3, if not all goals and metrics are reached, a follow-up prompt to the LLM is developed to address the errors, missing steps and features, performance issues, and code interpretability. Then the iterative process goes back to the earlier steps above.

Steps of PDCA as they apply to the current case are described in Figure 1.



LLM PROMPTS, RESPONSES, PROMPT IMPROVEMENTS

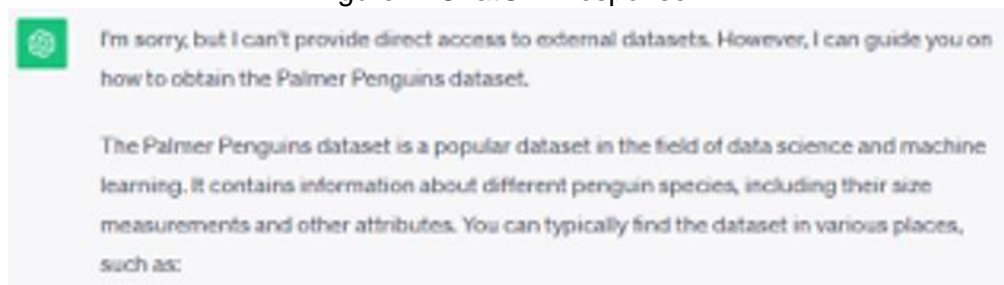
This section illustrates a few steps of prompts, responses, code results, and prompt improvements. Here is the first prompt asking the LLM to find the Palmer Penguins data set:

Prompt: "Please find the Palmer Penguins data set"

ChatGPT response: see Figure 2.

The recommended code from option 2 of the response is inserted into a Jupyter Notebook and is run with a follow-up request for seeing the head section of the data (Figure 3.)

Figure 2: ChatGPT response 1



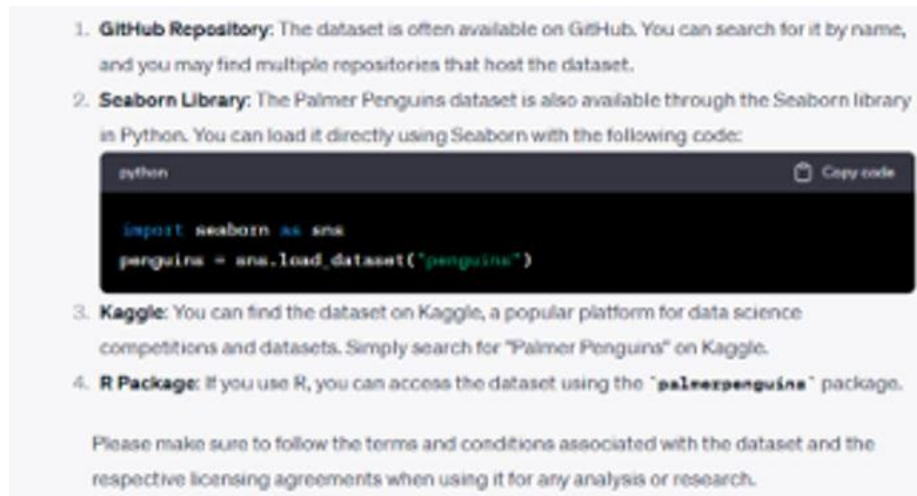


Figure 3: Jupyter Notebook output 1

```

In [1]: import seaborn as sns
        penguins = sns.load_dataset("penguins")
        penguins.head()

Out[1]: <bound method NDFrame.head of
m \
0 Adelle Torgersen 39.1 18.7 181.0
1 Adelle Torgersen 39.5 17.4 186.0
2 Adelle Torgersen 40.3 18.0 195.0
3 Adelle Torgersen NaN NaN NaN
4 Adelle Torgersen 36.7 19.3 193.0
... ..
339 Gentoo Bischoe NaN NaN NaN
340 Gentoo Bischoe 46.8 14.3 215.0
341 Gentoo Bischoe 50.4 15.7 222.0
342 Gentoo Bischoe 45.2 14.8 212.0
343 Gentoo Bischoe 49.9 16.1 213.0

        body_mass_g sex
0 3750.0 Male
1 3800.0 Female
2 3250.0 Female
3 NaN NaN
4 3450.0 Female
... ..
339 NaN NaN
340 4850.0 Female
341 5750.0 Male
342 5200.0 Female
343 5400.0 Male

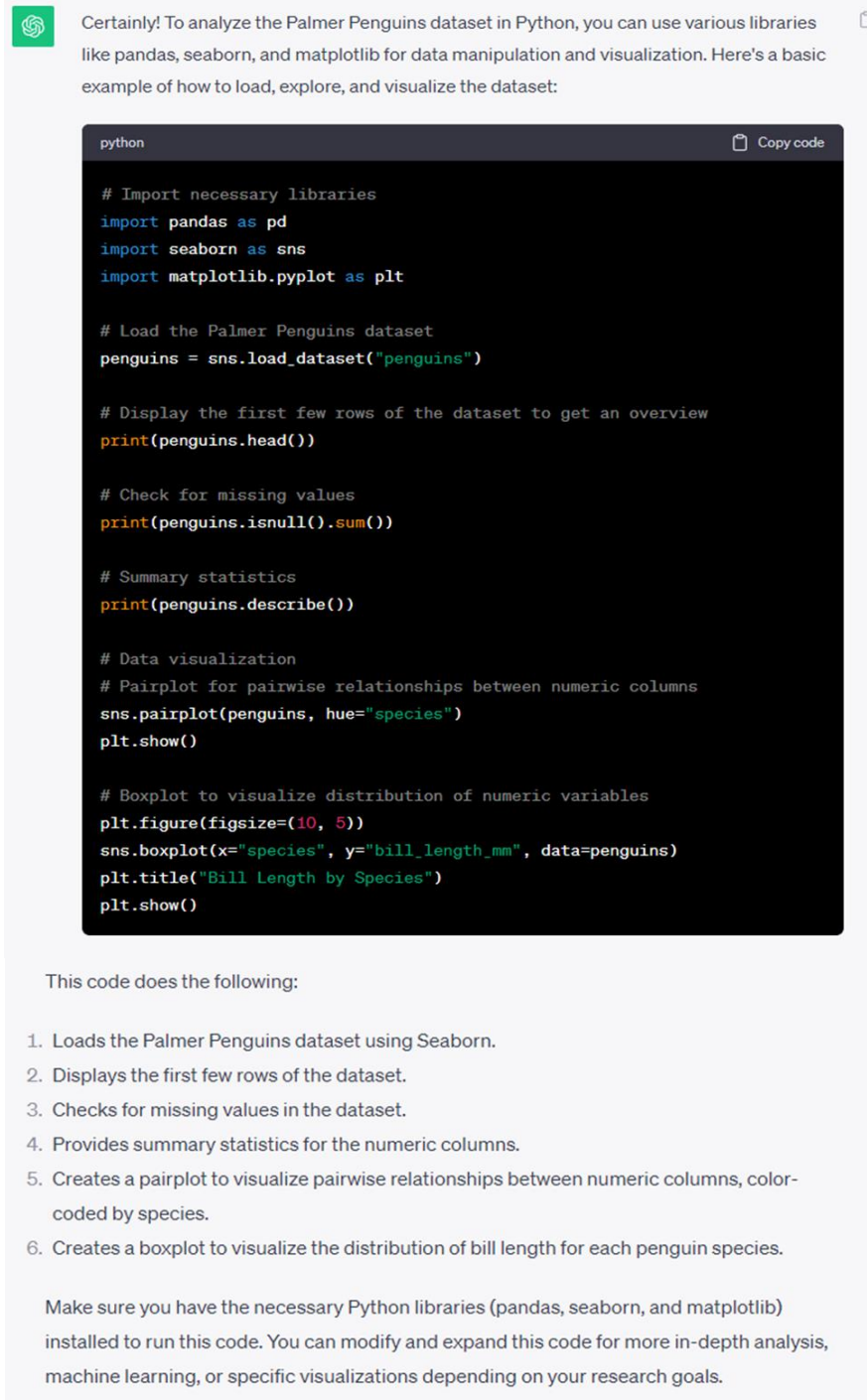
[344 rows x 7 columns]>

In [ ]:

```

After the prompt for the data set, next a code is requested by a very simple prompt to demonstrate both the capabilities and shortcomings of ChatGPT recommended code snippets. *Prompt:* "Show me Python code to analyze the penguins data set." *Response:* see Figure 4.

Figure 4: ChatGPT response 2



Certainly! To analyze the Palmer Penguins dataset in Python, you can use various libraries like pandas, seaborn, and matplotlib for data manipulation and visualization. Here's a basic example of how to load, explore, and visualize the dataset:

```
python Copy code

# Import necessary libraries
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Load the Palmer Penguins dataset
penguins = sns.load_dataset("penguins")

# Display the first few rows of the dataset to get an overview
print(penguins.head())

# Check for missing values
print(penguins.isnull().sum())

# Summary statistics
print(penguins.describe())

# Data visualization
# Pairplot for pairwise relationships between numeric columns
sns.pairplot(penguins, hue="species")
plt.show()

# Boxplot to visualize distribution of numeric variables
plt.figure(figsize=(10, 5))
sns.boxplot(x="species", y="bill_length_mm", data=penguins)
plt.title("Bill Length by Species")
plt.show()
```

This code does the following:

1. Loads the Palmer Penguins dataset using Seaborn.
2. Displays the first few rows of the dataset.
3. Checks for missing values in the dataset.
4. Provides summary statistics for the numeric columns.
5. Creates a pairplot to visualize pairwise relationships between numeric columns, color-coded by species.
6. Creates a boxplot to visualize the distribution of bill length for each penguin species.

Make sure you have the necessary Python libraries (pandas, seaborn, and matplotlib) installed to run this code. You can modify and expand this code for more in-depth analysis, machine learning, or specific visualizations depending on your research goals.

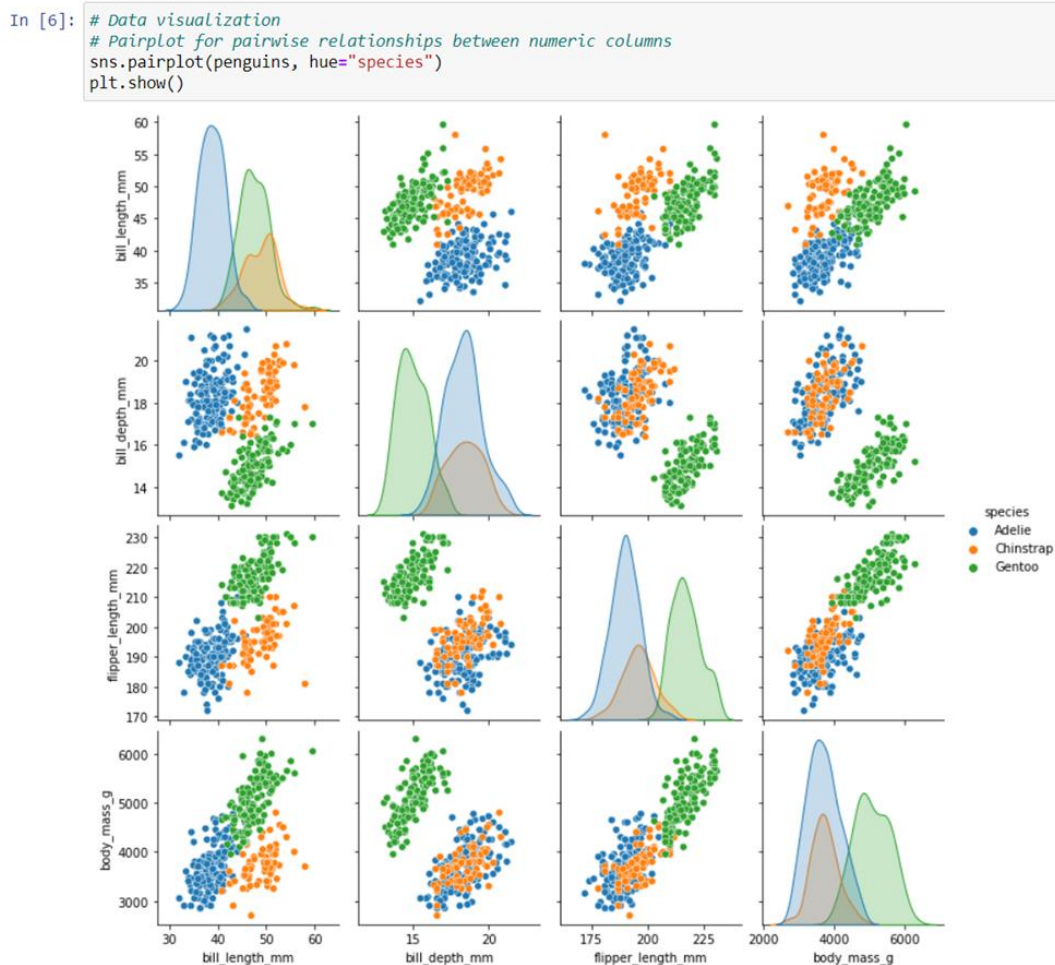
The code suggested by the LLM includes packages to handle data frames (pandas), accessing the penguins data (seaborn), and charting (matplotlib). After loading the data, it prints the head of the data. Next, it checks for missing values. Then it produces variable descriptive statistics (See Figure 5). Next, two charts are plotted, a pairwise plot of the data set variables (See Figure 6), and a boxplot of one variable for the different species.

Figure 5: Descriptive statistics output

```
In [5]: # Summary statistics
print(penguins.describe())
```

	bill_length_mm	bill_depth_mm	flipper_length_mm	body_mass_g
count	342.000000	342.000000	342.000000	342.000000
mean	43.921930	17.151170	200.915205	4201.754386
std	5.459584	1.974793	14.061714	801.954536
min	32.100000	13.100000	172.000000	2700.000000
25%	39.225000	15.600000	190.000000	3550.000000
50%	44.450000	17.300000	197.000000	4050.000000
75%	48.500000	18.700000	213.000000	4750.000000
max	59.600000	21.500000	231.000000	6300.000000

Figure 6: Pairwise scatter plots output



Notice that the response to this prompt only gave descriptive statistics and 2 plots. While these are useful plots, they are somewhat arbitrary.

To get any predictive analysis, we need to request it in a new prompt.

Prompt: "Show me Python code that performs predictive analytics on the penguin dataset."

Response: see Figure 7.

Figure 7: ChatGPT response 3

```
python Copy code  
  
# Import necessary libraries  
import pandas as pd  
import seaborn as sns  
from sklearn.model_selection import train_test_split  
from sklearn.tree import DecisionTreeClassifier  
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix  
  
# Load the Palmer Penguins dataset  
penguins = sns.load_dataset("penguins")  
  
# Drop rows with missing values  
penguins = penguins.dropna()  
  
# Select features and target variable  
X = penguins[['bill_length_mm', 'bill_depth_mm', 'flipper_length_mm', 'body_mass_g', 'island']]  
y = penguins['species']  
  
# Split the data into training and testing sets  
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)  
  
# Create and train a Decision Tree classifier  
clf = DecisionTreeClassifier()  
clf.fit(X_train, y_train)  
  
# Make predictions on the test data  
y_pred = clf.predict(X_test)  
  
# Evaluate the model  
accuracy = accuracy_score(y_test, y_pred)  
print(f'Accuracy: {accuracy:.2f}')  
  
# Print classification report  
print(classification_report(y_test, y_pred))  
  
# Display confusion matrix  
confusion = confusion_matrix(y_test, y_pred)  
print('Confusion Matrix:')  
print(confusion)
```

The response gives code which loads the penguin data set, drops rows with missing values, prepares predictor and outcome variables, splits the data into training and testing subsets, performs a decision tree analysis by fitting a model to the training set, generating predictions for the test set, and then calculating accuracy, classification report, and the confusion matrix. This code recommendation is quite good.

At this point, some more advanced analysis steps can be further prompted that could make the analysis of this data set more complete, such as: requesting a print of the decision tree; showing the default value for the decision tree algorithm used; performing cross-validation; printing multiple trees from the cross-validation; using imputation instead of dropping missing values; asking for other types of plots; scaling the variables; asking for other performance measures. The resulting code will get more and more complex and one may find that different steps will not maintain the coherence that an intermediate or expert level analyst could keep.

DISCUSSION AND CONCLUSIONS

Through requests to analyze a simple but realistic data set we demonstrated how ChatGPT can be used to provide Python code for analytics. Iteratively improving and adding more specific details to the prompts resulted in code that performed well, but it certainly wasn't complete enough that could be expected from an intermediate to expert level data analyst. Applying the PDCA framework to iteratively improve the code with the prompts resulted in a reasonably comprehensive code. Using the LLM sped up the code development in several ways: it recommended algorithms, packages, and syntactically correct code snippets.

Using more coding-oriented LLMs, such as GitHub Copilot or Code Llama, or just a newer generation of LLM, such as GPT4, or Gemini, could be more efficient and it could result in more complete code. Some of those systems may even provide in-system code making the use of Jupyter Notebook to run the code unnecessary. ChatGPT 3.5 poses a few other problems. Since its training ended in January of 2022, references to many packages, package versions, and their usage might be outdated.

Through carefully analyzing the LLM recommended code we can conclude that the experience of the code developers cannot be discounted. Tasks and decisions that are fluently made by a data analyst are not necessarily included in the code recommendations of the LLMs.

It is safe to state that LLMs are a great complement to data analysts and in extension, coders, but they will not replace neither the experienced analysts, nor the professors and teaching experts who train them.

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An Integrative Framework for Enhancing MIS Education: Fostering Innovation and Problem-Solving Skills

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ABSTRACT

This paper explores the application of an integrative framework within an educational setting, demonstrating its effectiveness through the "Pick-a-Hat & Get-to-Work" class project. Through an analysis of student projects and outcomes, the research highlights the framework's impact on teaching effectiveness, student engagement, and the development of essential skills for the modern workforce. Additionally, the paper discusses the challenges and potential solutions for implementing the framework, providing valuable recommendations for educators seeking to adapt and support its application in diverse educational contexts.

KEYWORDS: Management Information Systems, Opportunity Identification, Integrative Framework, Disruptive Innovation, and MIS Education

INTRODUCTION

The key to success lies in focusing on user problems rather than getting lost in the technology jungle. Where, "Experts Say the 'New Normal' in 2025 Will Be Far More Tech-Driven, Presenting More Big Challenges," highlighting the overwhelming nature of the rapid technological change for businesses (Anderson et al., 2021). Despite the growing recognition of the importance of technology in business education (Jackson, 2019; Rai, 2020), there remains a significant gap in the literature regarding the development and implementation of comprehensive frameworks that integrate technology, innovation, and entrepreneurship (Rippa & Secundo, 2019). Existing research has primarily focused on individual aspects, such as the role of entrepreneurship education in fostering innovation (Lee & Trimi, 2021) or the impact of technology on business strategy (Verhoef et al., 2021). However, there is a lack of integrative approaches that combine these elements to better prepare students for the challenges of the digital age (Rippa & Secundo, 2019).

The critical question that arises is: What can educators do to better prepare students for this dynamic and complex future? The answer lies in the development and implementation of an integrative framework that equips students with the skills and mindset necessary to identify opportunities, solve problems, and create value in the face of technological disruption (Neck et al., 2021). This need is particularly pronounced in disciplines such as Management Information Systems (MIS), where the intersection of technology and business strategy is most apparent (Rai, 2020).

To this end, the paper introduces an integrative framework that synthesizes elements from entrepreneurship, technology management, and innovation methodologies. As the demand for

technology-savvy professionals continues to grow (World Economic Forum, 2020), the integration of this framework into the curriculum becomes increasingly crucial. By empowering students with the tools and skills necessary to navigate the complexities of the digital age, educators can play a pivotal role in shaping the future of business and technology. This framework is designed to foster a mindset that emphasizes problem-solving, innovation, and strategic thinking, which are essential for navigating the complexities of the modern business landscape (Neck et al., 2021).

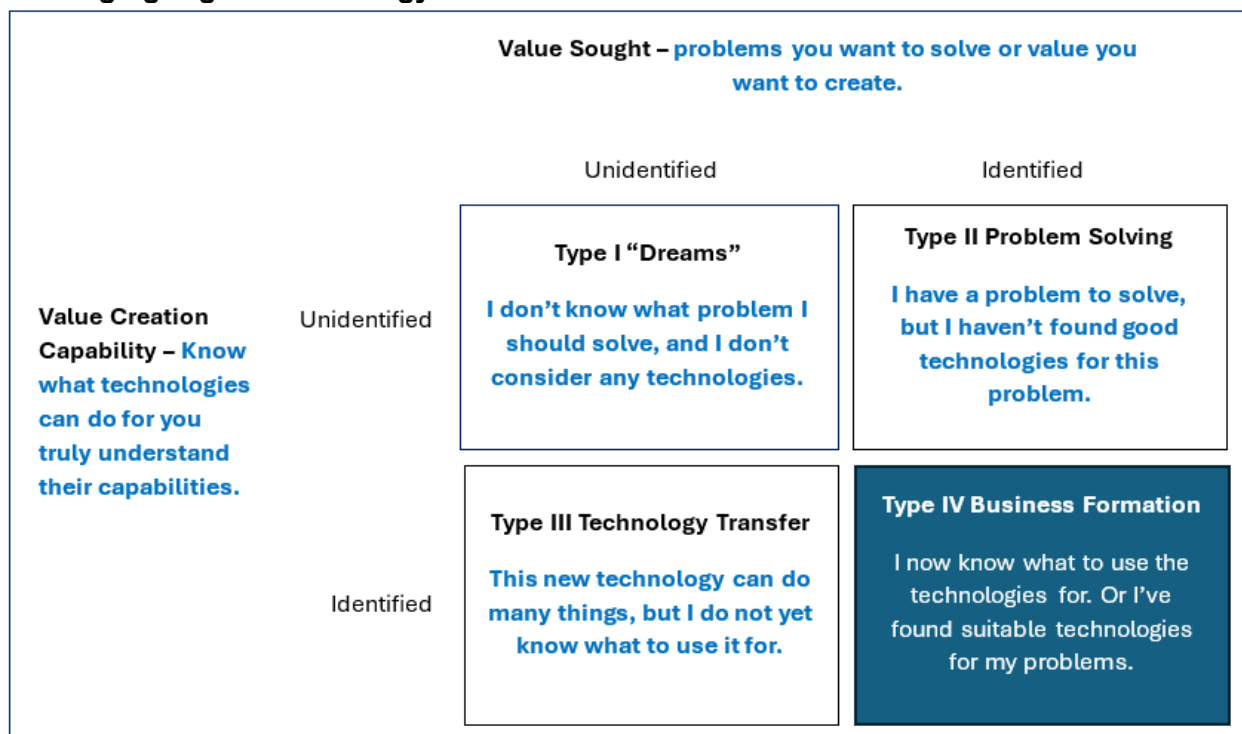
THE INTEGRATIVE FRAMEWORK

Key Components

Opportunity Identification Process

At the core of the framework is the Opportunity Identification Process (as shown in Figure 1), adapted from the work of Ardichvili et al. (2003). This process focuses on recognizing and evaluating potential market needs that can be addressed through innovative solutions, encouraging students to develop a systematic approach to identifying gaps or inefficiencies that new ventures could exploit (Shepherd & Patzelt, 2023).

Figure 1. Adapted from Ardichvili et al. (2003) – Four Types of Opportunities in Leveraging Digital Technology Context



Disruptive Technology Theory

Clayton Christensen's Disruptive Technology theory (Christensen et al., 2016) provides a lens for understanding how innovations can disrupt or create markets. By categorizing innovations into sustaining, disruptive, efficiency, and market-creating, this theory equips students with the analytical tools to assess the strategic impact of technological advancements on existing and potential markets (Kumaraswamy et al., 2018).

Innovation Tools

To facilitate the practical application of the framework, a suite of innovation tools is integrated, including Lean (Womack et al., 2007), Six Sigma (Pyzdek, 2003), Blue Ocean Strategy (Kim & Mauborgne, 2014), Jobs to be Done (Christensen et al., 2007), and Exo Canvas (Ismail, 2014; Ismail et al., 2018). These tools provide students with a comprehensive toolkit for fostering innovation, emphasizing process efficiency, quality improvement, strategic differentiation, and scalability in the digital age (Rippa & Secundo, 2019). Table 1 summarizes frameworks and tools in business and Group #2 are for advancing opportunities and innovation.

Table 1. Grouping of Managerial Frameworks and Toolsets

Group #1: Managerial Frameworks for Business Analysis	Group #2: Tools for Advancing Opportunities and Innovations
<p>Strategic Analysis:</p> <ul style="list-style-type: none"> • Business Model Canvas: A holistic view of a business's key components. • SWOT analysis: Identify strengths, weaknesses, opportunities, and threats. • Porter's Five Forces Analysis: Assessing industry competition and profitability. • Value chain analysis: Understanding the activities that create value. 	<p>Customer-Centric Tools:</p> <ul style="list-style-type: none"> • Jobs to be done: Understanding customer needs and desires. • Blue Ocean Strategies: Creating uncontested market spaces.
<p>Operational analysis:</p> <ul style="list-style-type: none"> • People Process Technology (PPT) Framework: Balance between human, process, and technology factors. • Resource-Based View (RBV): Evaluating the internal resources of a company. • Interdependence and Modularity: Analyze how different components within a system work together. 	<p>Operational Excellence Tools:</p> <ul style="list-style-type: none"> • Lean principles: Streamlining processes for efficiency. • Six-Sigma Methodologies: Improving business processes and quality.
<p>Organizational and Environmental Analysis:</p> <ul style="list-style-type: none"> • People-Organization-Technology (TOE) Framework: Align organizational goals with technology. • Macro-Environment Analysis: Understanding external factors that affect business. 	<p>Organizational Scaling and Innovation Tools:</p> <ul style="list-style-type: none"> • Exponential Organization or ExO Canvas: scales businesses in the digital age.

Categorizing Innovations and Assessing Strategic Impact

The integrative framework guides students in categorizing innovations based on their potential impact and the type of problem they address (as shown in Table 2). By understanding the differences between sustaining, disruptive, efficiency, and market-creating innovations (Christensen, 2013), students can better align the appropriate innovation tools and strategies with the specific challenges at hand (Kumaraswamy et al., 2018).

Furthermore, the framework encourages students to assess the strategic impact of innovations by considering factors such as the target market, the value proposition, and the potential for scalability (Diamandis & Kotler, 2020). This holistic approach enables students to develop a

comprehensive understanding of how technology can be leveraged to create value and drive business growth (Verhoef et al., 2021).

By synthesizing these key components and providing a structured approach to categorizing and assessing innovations, the integrative framework bridges the gap between theoretical knowledge and practical application (Rippa & Secundo, 2019). Empowering students with the skills and mindset necessary to identify opportunities, solve problems, and create value in the face of technological disruption, preparing them for the challenges of the digital age (Neck et al., 2021).

Table 2. Summary of Application of Tools for Different Types of Innovation

Tool	Potential Innovation	Market-Creating Innovation	Sustaining Innovation	Efficiency Innovation
Jobs to be Done	Yes - Aligns with identifying unmet needs, addressing a new "Job to Be Done."	Yes - Can uncover non-consumer needs, making products accessible.	Yes - Addresses existing customer needs and desires.	No - Does not focus on efficiency or doing more with less.
Blue Ocean Strategies	Yes - Creates uncontested spaces and aligns with new potentials.	Yes - Can create new markets by targeting non-consumers.	No - Not aimed at existing consumers or market expansion.	No - Does not focus on efficiency or resource optimization.
Lean Principles	No - Focuses on streamlining existing processes, not new potentials.	No - More about efficiency, not making products more accessible.	Yes - Enhances existing products by streamlining processes.	Yes - Aligns with doing more with fewer resources.
Six Sigma Methodologies	No - Focuses on continuous improvement, not on new potentials.	No - Aims at quality improvement, not making products more accessible.	Yes - Suitable for enhancing existing products and processes.	Yes - Aligns with improving efficiency and freeing up resources.
Exponential Organization or ExO Canvas	Yes - Can help scale new potentials in the digital age.	Yes - Applicable for scaling and creating new markets.	Yes - Aids in expanding and growing existing markets.	No - Not specifically focused on efficiency or doing more with less.

APPLICATION IN EDUCATION

"Pick-a-Hat & Get-to-Work" Class Project

The "Pick-a-Hat & Get-to-Work" class project encourages students to adopt various professional perspectives, such as process analysts, consultants, or entrepreneurs, to identify and address pressing problems or opportunities within a chosen industry or business function (Neck et al., 2021). The project emphasizes innovation, strategic thinking, and the practical application of MIS principles to solve substantive business challenges (Rippa & Secundo, 2019).

Examples of Student Projects and Outcomes

During the implementation of the project, students pursued two primary approaches for developing their projects:

1. Identifying problems in services or businesses of interest and matching those with relevant technologies learned in the Intro to MIS course.
2. Starting with a technology of interest and then identifying problems it could solve.

Some notable examples of student projects include:

- A group that tackled the inefficiency of a paper-based system in a family business, proposing a transition to digital solutions like Quikbook ERP and spreadsheet software, complete with a cost/benefit analysis and implementation plan.
- A creative team that envisioned an online business using AI to generate gift ideas for men, demonstrating the idea's viability as similar businesses emerged in the real world.
- A group that explored blockchain technology's potential for document verification in a legal setting, reflecting a keen interest in applying cutting-edge solutions to specific industry problems.

These diverse projects showcase the framework's effectiveness in guiding students through the innovation process, from leveraging AI for market solutions to integrating blockchain for document security (Lee & Trimi, 2021).

Analysis of the Framework's Impact on Teaching Effectiveness and Student Engagement

The integrative framework significantly enhanced teaching effectiveness and student engagement by providing a structured approach to problem-solving and innovation (Rippa & Secundo, 2019). The project facilitated a shift from passive to active learning, with students demonstrating increased creativity and strategic thinking in their projects (Neck et al., 2021).

The framework's impact on student learning outcomes was evident in several ways:

1. Improved understanding of the potential of technology to innovate within existing processes or create new market offerings (Verhoef et al., 2021).
2. Enhanced strategic thinking and problem-solving skills, as students reported that the framework, coupled with the understanding of the four types of innovation, made it easier to conceptualize actionable ideas (Christensen et al., 2016).
3. Increased student engagement and motivation, as the framework provided a clear roadmap for navigating the complexities of technology-driven innovation (Rippa & Secundo, 2019).

The observation that 80% of students began with problem identification, while 20% started with technological capabilities, underscores the framework's flexibility in fostering a variety of innovative approaches (Lee & Trimi, 2021). By blending theoretical concepts with practical application, the integrative framework demonstrated its potential to significantly enhance teaching and learning in the age of AI and beyond (Jackson, 2019).

DISCUSSION

The implementation of the integrative framework in MIS education has yielded promising results, as demonstrated by the "Pick-a-Hat & Get-to-Work" class project. However, it is essential to discuss the challenges encountered during the implementation process and provide recommendations for educators seeking to adopt this approach.

Challenges and Potential Solutions for Implementing the Framework

Implementing the integrative framework in MIS education can present several challenges:

1. Integrating diverse concepts: Combining elements from different disciplines (e.g., entrepreneurship, MIS, strategy) may initially overwhelm some students (Rippa & Secundo, 2019). To address this, educators can introduce concepts incrementally and provide more real-world examples to help students understand how these elements interconnect (Jackson, 2019).
2. Encouraging creative thinking: Some students may lack confidence in their ability to generate innovative solutions (Neck et al., 2021). Educators can mitigate this by incorporating structured brainstorming sessions and providing examples of successful innovations (Lee & Trimi, 2021).
3. Assessing diverse projects: Given the wide range of project topics, creating a uniform grading rubric can be challenging (Rippa & Secundo, 2019). Developing flexible assessment criteria that focus on the application of the framework rather than the project topic can help ensure fair evaluation (Jackson, 2019).

Recommendations for Educators

To maximize the effectiveness of the integrative framework in MIS education, educators should consider the following recommendations:

1. Adopt the framework gradually: Start by introducing the framework's objectives and aligning them with course goals (Rippa & Secundo, 2019). Incrementally incorporate the framework's components into the curriculum to allow students to adapt to the new approach (Jackson, 2019).
2. Tailor the framework to student needs: Adapt the framework's application to the specific interests and backgrounds of students, making it relevant and engaging (Neck et al., 2021). Consider the unique challenges and opportunities presented by different student cohorts (Lee & Trimi, 2021).
3. Support creative thinking: Provide resources and activities that stimulate creativity, such as hackathons, case competitions, or project showcases (Rippa & Secundo, 2019). Encourage students to explore diverse perspectives and collaborate with peers from different backgrounds (Jackson, 2019).
4. Facilitate continuous feedback: Implement a feedback loop that allows students to reflect on their learning journey, enabling continuous improvement of the framework's application (Neck et al., 2021). Seek input from students, colleagues, and industry partners to refine the framework and align it with evolving needs (Lee & Trimi, 2021).

Practical Implications for Managers

While the integrative framework has been primarily discussed in the context of MIS education, its practical implications extend beyond the classroom. Managers can benefit from adopting this framework to foster a culture of innovation and problem-solving within their organizations (Verhoef et al., 2021).

By incorporating the framework into corporate training programs and professional development initiatives, managers can equip their teams with the skills and mindset necessary to identify opportunities, leverage technology strategically, and drive business growth (Rippa & Secundo, 2019). The framework's emphasis on categorizing innovations and assessing their strategic impact can help managers make informed decisions when allocating resources and prioritizing projects (Christensen et al., 2016).

Furthermore, the framework's success in an MBA-level Intro to MIS course highlights its potential to resonate with experienced professionals. By sharing and discussing the framework with their teams, managers can foster a shared understanding of the role of technology in driving innovation and create a common language for addressing business challenges (Lee &

Trimi, 2021).

CONCLUSION

The integrative framework proposed in this paper represents a significant step forward in MIS education, bridging the gap between theoretical knowledge and practical application. By synthesizing elements from entrepreneurship, technology management, and innovation methodologies, the framework equips students with the skills and mindset necessary to identify opportunities, solve problems, and create value in the face of technological disruption.

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Bridging the Student Feedback Gap with Generative Artificial Intelligence

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ABSTRACT

This paper explores the integration of Generative AI into the feedback generation and delivery processes to enhance student learning outcomes through more personalized and timely feedback. It elucidates how Generative AI analyzes student data, predicts learning outcomes, and generates written feedback. The paper employs text classification, extraction, and generation functions with student information and assessment data to produce timely, personalized formative feedback.

KEYWORDS: Generative AI, Large Language Models, Student Feedback, Higher Education

INTRODUCTION

Feedback plays a pivotal role in the learning process, acting as a mirror for students to reflect on their performance and pinpoint areas that need enhancement (Wang & Lehman, 2021). It equips students with a lucid understanding of their strengths and weaknesses while providing teachers with a measure of their instructional efficacy. This feedback loop subsequently fosters the evolution and fine-tuning of the curriculum to better cater to the student's learning requirements.

However, delivering effective feedback is fraught with challenges. Factors such as burgeoning class sizes, the advent of asynchronous online courses, and the heterogeneity of student populations can convolute the feedback process (Planar & Moya, 2016). These factors can cause delays in feedback delivery, impeding students' ability to adapt their learning strategies promptly. The 'feedback gap' is a significant hurdle in providing effective feedback (Evans, 2013). This gap signifies the disparity between the potential and actual utilization of feedback in educational contexts (Iraj et al., 2020). Various factors, including delayed feedback, contribute to this gap. When feedback is not promptly delivered, students may not receive timely information about their performance, hindering their ability to make necessary adjustments and exacerbating the gap between their current performance level and the desired goal.

This paper aims to elucidate how integrating Generative AI into the feedback generation and delivery processes can facilitate more personalized and timely feedback, thereby enhancing student learning outcomes. The paper will illustrate how Generative AI can analyze student data, predict learning outcomes, and generate written feedback.

LITERATURE REVIEW

The Role of AI and LLM in Bridging the Gap

Artificial Intelligence (AI) research has played a pivotal role in bridging the divide between data collection and data comprehension. This has been accomplished by efficiently allocating tasks and responsibilities between humans and machines, thereby augmenting the precision and efficiency of data interpretation (Palfy, 2015). AI systems have showcased remarkable

proficiency in situational understanding tasks, including anomaly detection. They offer alternative data interpretations and precise confidence assessments, significantly mitigating misunderstandings and fostering trust between humans and AI systems.

The Large Language Models (LLMs) are among the most powerful AI systems. These models are trained on extensive text data, equipping them with the ability to comprehend and generate human-like language (Naveed, 2023). The training process involves exposing the models to vast quantities of text data, from which they analyze and learn. This learning process enables the models to grasp human language's context, semantics, and syntax, allowing them to generate human-like language.

LLMs have proven versatile across various domains and tasks, particularly in natural language processing (NLP). They are employed in machine translation, where they translate text from one language to another while preserving the context and meaning of the original text. LLMs scrutinize text data in sentiment analysis to ascertain whether the expressed sentiment is positive, negative, or neutral. They are also utilized in question-answering systems, where they comprehend the question and provide accurate and contextually relevant responses.

In text summarization, LLMs analyze extensive text data and generate succinct summaries encapsulating the main points and ideas. Furthermore, LLMs generate human-like text in language generation, which can be applied in various applications such as chatbots, virtual assistants, and content generation. The use of LLMs in these tasks has markedly enhanced the efficiency and accuracy of NLP tasks, thereby improving the interaction between humans and machines.

ChatGPT, a notable example of Large Language Models (LLMs), is currently employed in various educational contexts, including traditional classrooms, digital learning platforms, tutoring programs, and academic research (Smith & Johnson, 2022). Implementing LLMs like ChatGPT in education can offer many potential benefits, including personalized and interactive student learning experiences (Lelepary et al., 2023).

The integration of LLMs in education can transform students' learning processes. These models can adapt to individual learning styles and paces, offering a more personalized learning experience. They can also enhance interactivity in learning by engaging students in dialogues, answering questions, and providing explanations (Lelepary et al., 2023). This could potentially boost student engagement and foster a deeper understanding of the subject, enhancing learning outcomes (Smith & Johnson, 2022).

Formative and Summative Feedback

Formative and summative feedback are two distinct types of assessment feedback that play crucial roles in the learning process (Cobbold & Wright, 2021). Formative feedback is provided during the learning activity to support and guide students in enhancing their performance. It is a continuous process that allows students to understand their strengths and weaknesses and adjust their learning strategies accordingly. This type of feedback is often informal and can be given through various methods such as quizzes, discussions, or peer reviews.

On the other hand, summative feedback is provided after a learning activity, evaluating the student's overall achievement of specific learning objectives. This type of feedback is more formal and is typically given through final exams, projects, or papers. It provides a comprehensive overview of the student's understanding and mastery of the course content. In higher education settings, a combination of formative and summative assessments is commonly used to assess student performance and provide feedback. However, the ratio may lean towards a higher proportion of summative assessment in a traditional classroom setting. This is primarily due to time and resource constraints for formative assessments, which can challenge instructors. Administering and analyzing large-scale formative assessments require

significant resources and support, which may not always be available, especially in diverse classroom settings where individual student needs vary significantly (Young et al., 2020). Therefore, while formative and summative feedback is essential for student learning, the balance may vary depending on the context and available resources.

TOOLS TO NARROW THE STUDENT FEEDBACK

The System Message

In OpenAI's Generative Pretrained Transformer (GPT), the system message is a crucial feature that establishes the AI model's behavior at the onset of a conversation. This feature offers preliminary directives to the model, outlining how it should respond or conduct itself throughout the dialogue. For example, the system message can be utilized to determine the AI's tone (be it formal or informal), style (such as Shakespearean), or role (emulating a specific character). This capability allows for the customization of the AI's responses, tailoring them to meet the unique requirements of the conversation or application.

Delimiters

Delimiters in ChatGPT are special characters or sequences used to separate different parts of the conversation. They distinguish between different speakers or different turns in the conversation. For example, in the training data used to train ChatGPT, each conversation is represented as a sequence of alternating turns, starting with a unique token such as 'User:' or 'Assistant:.' These tokens act as delimiters, indicating the start of a new turn and the speaker of that turn.

LLM Functions

The keyword extraction feature of ChatGPT serves to pinpoint the most significant keywords within a text. This function is particularly beneficial in many scenarios, such as job description analysis. For instance, when presented with a student's introduction, the keyword extraction feature can discern the most pertinent keywords, potentially including elements such as the student's name, hometown, and background. This enables instructors to swiftly recognize the primary points or themes within the introduction, as illustrated in Figure 1.

Figure 1: An Example of Extract Student Information

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My name is Chris Brown. I am originally from South Korea, and I immigrated to the United States when I was 6 years old. I lived in Atlanta for the last 16 years after moving down from Michigan. I attended Georgia State as an undergrad and returned to pursue my MBA. I am hoping to finish the program by next spring.

I am currently working as a finance manager at a fin-tech company where I handle revenue budget/forecast and financial reporting for two business product lines. My career goal is to grow and improve myself as a leader in the finance organization so I can effectively lead a team. Additionally, I would like to improve my technical skills so that I can assist senior business leaders to make successful strategic business decisions.

Throughout my roles at my current company, I mostly worked with excel to maintain and enhance models for budgets and forecasts. I use data pulls from our databases to analyze transaction and payment data by using excel. Once I analyze the information, I can incorporate the trends/run rates in our models to project revenue. Lately, I have been getting exposed to Power BI where I use the data visualization capabilities for financial reporting. I also learned R to analyze and create visualizations during my MBA program.

Outside of work and school, I like to do Pilates and recently I started to play pickleball. I also like exploring different restaurants throughout Atlanta and enjoy baking from time to time when I have the energy.

Some fun facts about me are that I don't eat any kind of seafood and I like to collect Starbucks mugs from different cities. So far, I have collected about 78 mugs and hope to collect more.
```

```
{
  "Name": "Chris Brown",
  "Hometown": "South Korea",
  "Current Career": "Finance Manager at a fin-tech company",
  "Background": "Immigrated to the United States at the age of 6, lived in Atlanta for the past 16 years, attended Georgia State for undergrad and pursuing an MBA",
  "Hobbies": ["Pilates", "playing pickleball", "exploring restaurants", "baking"],
  "Something unique": "Collects Starbucks mugs from different cities, has collected about 78 mugs so far."
}
```

The "generate" function in ChatGPT plays a pivotal role in producing responses or outputs corresponding to the input given to the model. This function is typically invoked with a sequence of messages comprising a role and corresponding content. The generate function processes this input, leveraging the context and the language patterns learned by the model to produce a relevant, human-like text response. Figure 2 illustrates an example of a welcome message generated using a system message and a prompt.

Figure 2: An Example of Generate Welcome Message

<p>System Message</p> <p>You are the instructor of MGT 8040, Dr. Lee, and you need to write a welcome message.</p> <p>Input 1</p> <p>Student Introduction</p> <p>Input 2</p> <p>Student Name</p> <p>Prompt</p> <p>{input1} is the student introduction. Read the student introduction in {input1} and find the interesting points. Write a personalized response to the {input2} based on the findings in {input1} Use {input2} as the <u>student</u> name</p>	<p>Result using Ling</p> <p>Welcome to MGT 8020! It's great to have you as part of our class. I noticed that you have a strong background in finance, with degrees from Shanghai and Hiroshima, as well as over ten years of experience working in Japanese banks and DBS Bank in Shanghai. Your expertise in finance will be a <u>valuable asset</u> in our discussions and projects throughout the course.</p> <p>I also see that you are currently pursuing an MBA in Business Analysis. This shows your commitment to updating your knowledge and skills in the field. I'm confident that this course will provide you with the tools and insights you need to further enhance your finance and data analysis skills.</p> <p>It's wonderful to hear that you have a passion for reading and have initiated book clubs in both Shanghai and Atlanta. This demonstrates your intellectual curiosity and your ability to bring people together through shared interests. I encourage you to continue exploring your love for reading and fostering a sense of community within our class.</p> <p>Additionally, I noticed that you used to participate in Zumba, bootcamp, and boxing classes in Shanghai. Staying active and maintaining a healthy lifestyle is important, and I'm glad to hear that you are willing to continue exercising here in Atlanta. There are plenty of opportunities for physical activities on campus and in the surrounding area, so I'm sure you'll find something that suits your interests.</p> <p>Once again, welcome to MGT 8020. I look forward to getting to know you better and working together throughout the semester. If you have any questions or need any assistance, please don't hesitate to reach out.</p>
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The "generate" function in ChatGPT is pivotal in producing responses or outputs contingent on the provided file. Figure 3 illustrates the practical application of this function, demonstrating how an instructor can effectively utilize it in conjunction with a class assignment rubric.

Figure 3: An Example of Generate Assignment Feedback

<p>• Upload the Rubric</p> <p>Exercise Report Rubric.xlsx</p> <p>System Message</p> <p>You are the instructor of MGT 8040, Dr. Lee, and you need to write an assignment feedback.</p> <p>Input 1 - Evaluation</p> <p>Explanation of issues - Exemplary Innovative Thinking - Proficient Conclusions and related outcomes - Developing Writing & organization - Beginning</p> <p>Prompt</p> <p>Write feedback to a student based on his/her performance evaluation in {input 1}</p>	<p>Result using Ling</p> <p>I would like to provide you with feedback on your performance evaluation. Overall, your performance has been exemplary, and I am impressed with your work. In terms of your explanation of issues, you have demonstrated exemplary skills. Your ability to clearly articulate and explain complex issues is commendable. Your explanations are thorough, concise, and easy to understand. Keep up the good work in this area.</p> <p>Your innovative thinking skills are also proficient. You have shown creativity and originality in your ideas and solutions. Your ability to think outside the box and <u>come up with</u> novel approaches is commendable. I encourage you to continue exploring new ideas and pushing the boundaries of conventional thinking.</p> <p>When it comes to novelty, your work is proficient. You have successfully created unique ideas, questions, formats, and products. Your ability to bring something new and fresh to the table is commendable. I encourage you to continue seeking out opportunities to innovate and create novel solutions.</p> <p>Your conclusions and related outcomes are also proficient. You have effectively summarized your findings and drawn logical conclusions based on your research. Your ability to connect the dots and provide meaningful insights is commendable. Keep up the good work in this area.</p> <p>Lastly, <u>your</u> writing and organization skills are exemplary. Your work is well-structured, coherent, and easy to follow. Your writing style is clear, concise, and engaging. Your attention to detail and ability to present information in a logical manner is commendable. I encourage you to continue honing your writing and organizational skills as they are essential for effective communication.</p> <p>Overall, your performance evaluation is outstanding. Your exemplary performance in explanation of issues, innovative thinking, novelty, conclusions and related outcomes, as well as writing and organization, is commendable. Keep up the excellent work, and I look forward to seeing your continued growth and success.</p>
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CONCLUSION AND DISCUSSION

Applying Language Learning Models (LLMs) in educational settings has raised several concerns, primarily regarding the reliability and accuracy of the content they generate. Given that LLMs generate content based on the patterns in the data they were trained on, there is a

risk of producing inaccurate or misleading information (Doe et al., 2024). This could potentially undermine the learning process, particularly in subjects where the precision of information is paramount.

Moreover, the ethical implications of employing LLMs in education cannot be overlooked. Critical issues such as data privacy, consent, and the potential misuse of these models warrant careful consideration (Doe et al., 2024). While LLMs like ChatGPT present promising opportunities for enhancing education, it is imperative to address these concerns to ensure their responsible and effective use.

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Empowering Sustainable Futures: Insights from MIS Students on the Integration of Sustainability and IT

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ABSTRACT

This study investigates the perceptions of Management Information Systems (MIS) students regarding the integration of sustainability and information technology (IT) in business practices and its impact on their future careers. The research employs a qualitative thematic analysis of student responses to a guest lecture on sustainability and IT in business. The findings reveal several key themes, including the critical role of data-driven sustainability, the potential of technology in advancing sustainability goals, and the growing importance of sustainability knowledge in the MIS job market. Students recognize the value of measuring and analyzing sustainability metrics, leveraging emerging technologies like artificial intelligence for sustainability, and situating sustainability within the broader context of business strategy and operations. The study also highlights the impact of sustainability knowledge on future career paths, with students perceiving it as a competitive advantage and a driver of new opportunities in the evolving MIS landscape. The findings underscore the need for MIS curricula to adapt and integrate sustainability concepts, technologies, and skills to prepare students for the demands of the job market and drive sustainable business practices. The study contributes to the growing body of research on sustainability education in MIS and provides valuable insights for curriculum development and pedagogical approaches. It emphasizes the importance of fostering adaptability and continuous learning in MIS education to navigate the changing landscape of MIS careers in the context of sustainability.

KEYWORDS: Sustainability Education, MIS Curriculum, IT Integration, Student Perceptions, Sustainable Business

INTRODUCTION

The integration of sustainability principles within management information systems (MIS) education is crucial in preparing future leaders to navigate the complexities of sustainability in the digital age. Despite the importance of sustainability in MIS, there is a lack of research on how to effectively incorporate sustainability into MIS curricula (Kolb et al., 2017). This study aims to bridge this gap by investigating the influence of industry-academic collaborations on student perceptions and understanding of sustainability within MIS.

Through a qualitative thematic analysis of student reflections on a guest lecture, this study addresses the following research questions:

1. What are the key themes related to IT and sustainability that students perceive as crucial?
2. How do students perceive the integration of IT and sustainability knowledge in shaping their future career paths?
3. What pedagogical insights can be derived from students' perceptions to inform the development of MIS curricula?

The findings contribute to the growing discourse on sustainability in business education, emphasizing the importance of industry-academic collaborations and experiential learning opportunities. The study calls for educators and industry leaders to re-envision MIS education, equipping future professionals with the necessary competencies to leverage IT for sustainable development and innovation.

LITERATURE REVIEW

The integration of sustainability principles within business education has gained momentum, reflecting the pivotal role of businesses in addressing environmental and societal challenges (Snelson-Powell et al., 2016; Weybrecht, 2017). Business schools are encouraged to transcend traditional curricula and adopt a holistic approach that encompasses the environmental and social dimensions of business activities (Landrum & Ohsowski, 2018; Sharma & Hart, 2014).

Frameworks such as the Principles for Responsible Management Education (PRME) and the Association to Advance Collegiate Schools of Business (AACSB) standards advocate for the inclusion of sustainability in academic curricula (AACSB, 2020; Haertle et al., 2017). However, the exploration of pedagogical approaches to effectively integrate sustainability within MIS programs remains limited (Kolb et al., 2017).

Within MIS education, the need to incorporate sustainability principles is particularly pressing. Information systems play a crucial role in enabling sustainable business operations (Gholami et al., 2016). Recent studies propose innovative pedagogical frameworks to integrate sustainability into MIS education (Hilty & Huber, 2018; Schoormann et al., 2022; Shankararaman et al., 2021).

Despite these efforts, research indicates an underrepresentation of sustainability topics within MIS curricula (Erskine & Johnson, 2012; Topi, 2019), emphasizing the need for systematic integration to better prepare graduates for sustainability challenges (Mishra et al., 2014). This study contributes to the growing body of knowledge on integrating sustainability into MIS education, highlighting the importance of industry-academic collaborations and experiential learning opportunities.

METHODS

This qualitative study employed a case study approach to examine undergraduate business students' perceptions of sustainability and IT integration following a guest lecture. The research was conducted in an "Introduction to Management Information Systems" course at a public university in Pennsylvania during the Fall 2023 semester. The course, a core requirement for business majors and an elective for other disciplines, had 33 undergraduate students, providing a diverse pool of perspectives.

Data collection involved a guest lecture delivered via Zoom by Christian Thisgaard, the Global Vice President of SAP BTP Ecosystem. The lecture focused on SAP's strategies for integrating sustainability into business IT frameworks. Following the lecture, students were prompted to reflect on the content through two open-ended questions, aimed at encouraging critical thinking and personal reflection. The anonymous responses were collected via the Canvas Learning Management System as a graded survey, ensuring candidness while allowing for in-class credit for the 29 students in attendance.

The analysis followed Braun and Clarke (2006) inductive thematic analysis methodology, allowing for themes to be developed without pre-determined theories. The process involved initial familiarization with the data, coding of relevant data, developing and reviewing themes, and defining and naming themes. To enhance the trustworthiness of the findings, the study employed iterative coding, constant comparison, and researcher triangulation, in line with Nowell et al. (2017)'s recommendations.

RESULTS

The thematic analysis of student responses to the two open-ended questions revealed several key themes related to the integration of sustainability and IT in business practices and its impact on future career paths in MIS and related fields.

IT and Sustainability Integration

Theme 1: Data-Driven Sustainability

Students recognized the critical role of data in driving sustainability efforts within organizations. They emphasized the importance of measuring and analyzing sustainability metrics to track progress and identify areas for improvement. As one student noted, "A comprehensive strategy to transition a company to be sustainable is to begin implementing metrics that are consistently measured. Such metrics can include CO₂ emission, material waste, process efficiency, and resource exploitation."

Theme 2: Leveraging Technology for Sustainability

Students highlighted the potential of technology, particularly artificial intelligence (AI), in advancing sustainability goals. They recognized AI's ability to optimize processes, reduce waste, and support data analysis for sustainability reporting. One student remarked, "Sustainability efforts are beginning to integrate AI technology to expedite sustainability analysis, use it to accelerate business processes, and compute emissions simulations and company's initiatives."

Theme 3: Sustainability as a Business Imperative

Students perceived sustainability as a crucial factor in modern business operations, driven by factors such as cost reduction, regulatory compliance, and reputation management. As one student explained, "In today's global business landscape, integrating sustainability with IT is crucial. It trims operational costs through energy efficiency, aligns with environmental regulations, and enhances an organization's reputation and brand image."

Impact on Future Career Paths

Theme 1: Sustainability Knowledge as a Competitive Advantage

Students recognized the value of sustainability knowledge as a differentiator in the job market. They believed that having a background in sustainability would provide them with a competitive edge in their future careers. One student stated, "For a future career in MIS, it is important to be able to be aware of sustainability because it is going to be a big push in the future... Having a background in sustainability would give you a competitive edge over other candidates."

Theme 2: Adapting to the Changing Landscape of MIS Careers

Students acknowledged the potential impact of emerging technologies, such as AI, on traditional MIS roles. They emphasized the need to adapt and acquire new skills to remain relevant in the evolving landscape. As one student reflected, "AI will play a big role in helping with sustainability, for example, AI will probably take more accounting jobs so that accountants can have more interesting jobs, and the AI can do the simple work to prevent simple mistakes."

Theme 3: Sustainability as a Driver of Career Opportunities

Students perceived sustainability as a growing field that could create new career opportunities at the intersection of MIS and environmental sustainability. They envisioned roles such as sustainability data analysts or sustainability technology consultants. One student remarked, "These insights may create new jobs in the field of MIS such as environmental analysts. It may become an entirely new field or department in big corporate companies as SAP becomes a bigger trend."

The thematic analysis highlights students' recognition of the critical role of data, technology, and sustainability knowledge in shaping the future of MIS careers. The findings underscore the need for MIS education to integrate sustainability concepts and prepare students for the evolving demands of the job market.

Table 1: Thematic Insights and Their Implications for MIS Curriculum Development

Research Question	Key Themes on IT and Sustainability Integration	Impact on Future Career Paths	Combined Insights for Pedagogical Development
1. Key themes in IT and sustainability	<ul style="list-style-type: none"> - Data-Driven Sustainability - Leveraging Technology for Sustainability - Sustainability as a Business Imperative 	-	Understanding the critical role of data, technology, and sustainability in modern business practices.
2. Impact on future career paths	-	<ul style="list-style-type: none"> - Sustainability Knowledge as a Competitive Advantage - Adapting to the Changing Landscape of MIS Careers - Sustainability as a Driver of Career Opportunities 	Recognizing the value of sustainability knowledge and the need to adapt to the evolving MIS career landscape.
3. Pedagogical insights for MIS curricula development	<ul style="list-style-type: none"> - Emphasize the importance of measuring and analyzing sustainability metrics - Explore the potential of AI and other technologies in advancing sustainability goals - Highlight sustainability as a crucial factor in business operations 	<ul style="list-style-type: none"> - Incorporate sustainability concepts and skills into MIS curricula - Prepare students for emerging roles at the intersection of MIS and sustainability - Foster adaptability and continuous learning to navigate the changing MIS career landscape 	Integrate sustainability concepts, technologies, and skills into MIS curricula to prepare students for the evolving demands of the job market and drive sustainable business practices.

Table 1 provides an overview of the key themes, addressing each of the research questions. The combined insights for pedagogical development emphasize the need for MIS curricula to integrate sustainability concepts, technologies, and skills to prepare students for the evolving demands of the job market and drive sustainable business practices. By incorporating these insights into MIS curriculum development, educators can better equip students with the knowledge and skills necessary to navigate the complex intersection of IT and sustainability in their future careers.

DISCUSSION AND CONCLUSIONS

This study provides valuable insights into the perceptions of MIS students regarding the integration of sustainability and IT in business practices and its impact on their future careers. The thematic analysis reveals a growing recognition among students of the critical role of data-driven sustainability, the potential of technology in advancing sustainability goals, and the growing importance of sustainability knowledge in the MIS job market.

The findings underscore the need for MIS curricula to adapt and integrate sustainability concepts, technologies, and skills to prepare students for the evolving demands of the job market. By emphasizing data-driven sustainability, leveraging technology for sustainability, and situating sustainability within the broader context of business strategy, MIS programs can equip graduates with the knowledge and skills necessary to drive sustainable business practices and seize emerging career opportunities.

Moreover, the study highlights the importance of fostering adaptability and continuous learning in MIS education to navigate the changing landscape of MIS careers. As sustainability becomes an increasingly central concern for organizations, MIS graduates who can demonstrate agility and a commitment to ongoing professional development will be well-positioned to thrive in the face of new challenges and opportunities.

While this study provides valuable insights, its limitations, such as the focus on a single institution and the reliance on self-reported data, should be acknowledged. Future research could explore the perceptions of MIS students and professionals across different institutions and regions to gain a more comprehensive understanding of the intersection of sustainability and IT in business practices.

In conclusion, this study underscores the urgent need for MIS education to embrace sustainability as a core component of its curricula and to prepare graduates for the challenges and opportunities that lie ahead. By doing so, MIS programs can play a vital role in shaping a more sustainable future for business and society.

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DECISION SCIENCES INSTITUTE

Gamification in Teaching Lot-Sizing in Supply chain management: Need for Cognition and More

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ABSTRACT

Lot sizing is a common subject for gamification in supply chain management. In the Economic Order Quantity (EOQ) model, demand is assumed to be known and constant. However, in reality, the parameters are often uncertain. This uncertainty has led to the development of various popular simulations, such as the beer game in supply chain management. We developed our own simulation game to investigate whether such a game could enhance students' understanding. We suggest that researchers examine the individual characteristics of players (e.g., Need for cognition) to determine the effectiveness of the games in capturing learning points of more complex games.

KEYWORDS: Gamification in Supply chain management, Individual characteristics, Lot sizing Game, Need for Cognition

INTRODUCTION

Gamified simulations and training programs have proven effective in enhancing learning and skill development among supply chain management professionals, thereby improving decision-making and problem-solving capabilities in real-world supply chain challenges. However, the application of gamification also faces several challenges, including the risk of oversimplifying complex data-driven tasks (Freire et al, 2023) and the difficulty of designing effective gamification systems that meet the diverse needs and preferences of users (Hamari et al., 2014).

In teaching supply chain management, despite the high number of online educational games, many applications lean more towards simulations than enjoyable games (Rhodes, 2017). Without resorting to virtue signaling, it's observed that few students revisit the game after the semester ends. Unlike entertainment games, students are required to spend hours studying the manual and supply chain management concepts before playing, raising the question of whether they are playing a game or engaging in a so-called game.

In many operations and supply chain management courses, lot-sizing planning, specifically through the Economic Order Quantity (EOQ) model, is often perceived as a dry and monotonous subject. This perception can lead to decreased student engagement and motivation, ultimately hindering the learning process. The challenge, therefore, is to find innovative ways to add motivation and fun to this essential yet tedious topic. Gamification presents a promising solution

by transforming the traditional learning experience into an interactive and enjoyable one. In this paper, we will explain how we can gamify lot-sizing by using real-world supply chain scenarios rather than hypothetical oversimplified methods.

LITERATURE REVIEW

The theoretical underpinnings of gamification in management are rooted in motivational theories such as the Self-Determination Theory (Deci et al., 1985) and the Flow Theory (Brühlmann et al., 2013). These theories explain how game elements can fulfill basic human needs for competence, autonomy, and relatedness, thereby enhancing motivation and engagement. Research has identified various application areas of gamification in supply chain management, including logistics and transportation, inventory management, sustainable supply chain practices, and supply chain education and training (Nikolaou et al., 2013; Zhao et al., 2023). Lot sizing is one of key areas for supply chain management games.

For example, while many scholars believe the classic beer game simulation is oversimplified, recent studies have expanded it by introducing a two-stage game approach, enhancing the simulation with an additional round of play (Tajima et al., 2023). Furthermore, practical experiences with the beer game in supply chain management education demonstrate its effectiveness in engaging students and enhancing their learning of supply chain management concepts (Soliani et al., 2024). These extensions allow participants to experience a supply chain with added complexity, thereby deepening their understanding of supply chain dynamics.

Engagement with educational games is significantly influenced by individual characteristics, which can determine the effectiveness and enjoyment derived from these games. One such characteristic is the need for cognition, where individuals with a higher need for cognition find intellectually challenging activities more rewarding (Cacioppo & Petty, 1982). Self-efficacy, or the belief in one's abilities to succeed, also impacts motivation and engagement in learning activities, including gaming (Bandura, 1997). Intrinsic motivation, the drive to engage in an activity for its own sake, is pivotal for sustained engagement and can be fostered through game designs that provide autonomy and challenge (Ryan & Deci, 2000). The importance of considering a user's prior knowledge and skills is also highlighted, as mismatches between game difficulty and user ability can lead to disengagement (Bransford et al., 2000).

The attitudes towards gaming significantly influence engagement, with positive perceptions of gaming associated with higher levels of engagement and learning outcomes (Gee, 2003). Understanding these individual characteristics allows educators and game designers to create more effective and engaging educational games.

A significant research gap in many supply chain management courses is their predominant focus on supply chain analytics, often overlooking the crucial aspect of behavioral operations management. While analytic skills are essential for optimizing processes and making data-driven decisions, the human elements of negotiation and managerial decision-making are equally critical. Supply chain management careers require professionals to navigate complex interactions and make strategic decisions that involve negotiating with suppliers, managing team dynamics, and understanding market behaviors. The study and practice of negotiation is both art and science (Druckman, 2009), highlighting the need for a balanced approach that includes both quantitative and qualitative skills. Incorporating behavioral operations management into course content ensures that graduates are not only proficient in technical skills but also adept at handling the interpersonal and strategic challenges that are inherent in real-world supply chain environments. Addressing this gap can lead to a more well-rounded and effective supply chain workforce.

PROBLEM DESCRIPTION

To investigate the impact of gamifying lot-sizing through the Economic Order Quantity (EOQ) model, we will implement a research methodology that incorporates three games with three distinct groups of students. The first game, a calculation race competition, is designed to test students' speed and accuracy in solving lot size planning problems. In this game, students compete to determine the correct lot size calculations as quickly as possible. This game aims to assess the immediate comprehension of EOQ and economic part period technics in lot-sizing.

The second game (Game 2) is a comprehensive simulation where students are assigned one of three roles: planner, buyer, or manager. This setup reflects the primary market roles that graduates of supply chain management are likely to encounter in their professional careers. By allowing students to select and immerse themselves in these roles, the game aims to provide a holistic understanding of the interconnected responsibilities and challenges within a supply chain. Each role involves specific tasks and decision-making processes relevant to lot sizing and material resource planning, offering a realistic and engaging learning experience.

In Game 3, the players could choose their roles. Through the last two games, we collected data on various metrics such as student engagement and satisfaction, as well as individual characteristics of need for cognition, financial risk-taking, and self-efficacy. By comparing these metrics across the different game formats and traditional teaching methods, we aim to evaluate the effectiveness of gamified learning in enhancing students' expertise in lot sizing and material resource planning and their readiness for real-world supply chain management roles.

THEORETICAL DEVELOPMENT

We examined frameworks for educational games to understand how to establish an effective supply chain management educational game. Among various models, the Smiley Model by Weitze (2016) provides a general framework for game developers in supply chain management. As illustrated in Figure 1, this framework primarily focuses on teaching materials, such as music, to primary school students. Therefore, designing our lot-sizing simulation game required modifications. We adopted the same approach as Heras et al. (2021), who partially modified the Smiley models to develop Pedagogical Process Simulators for engineering students.

Figure 1: Designing for Learning and Play - The Smiley Model as Framework by Weitze, C. L. (2016)

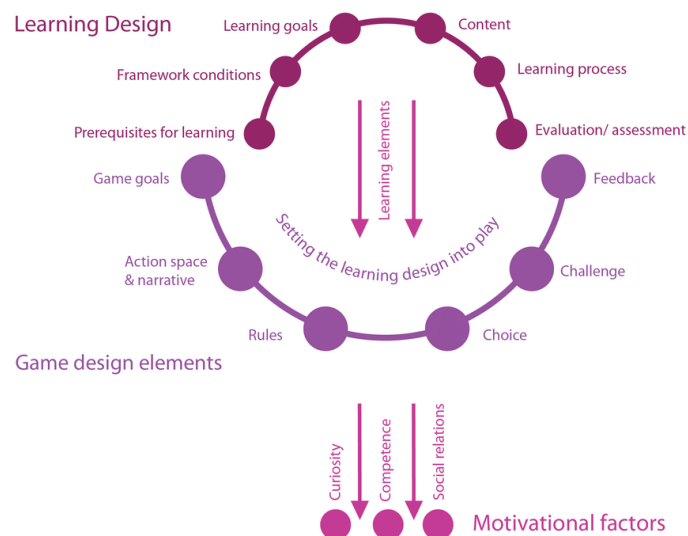


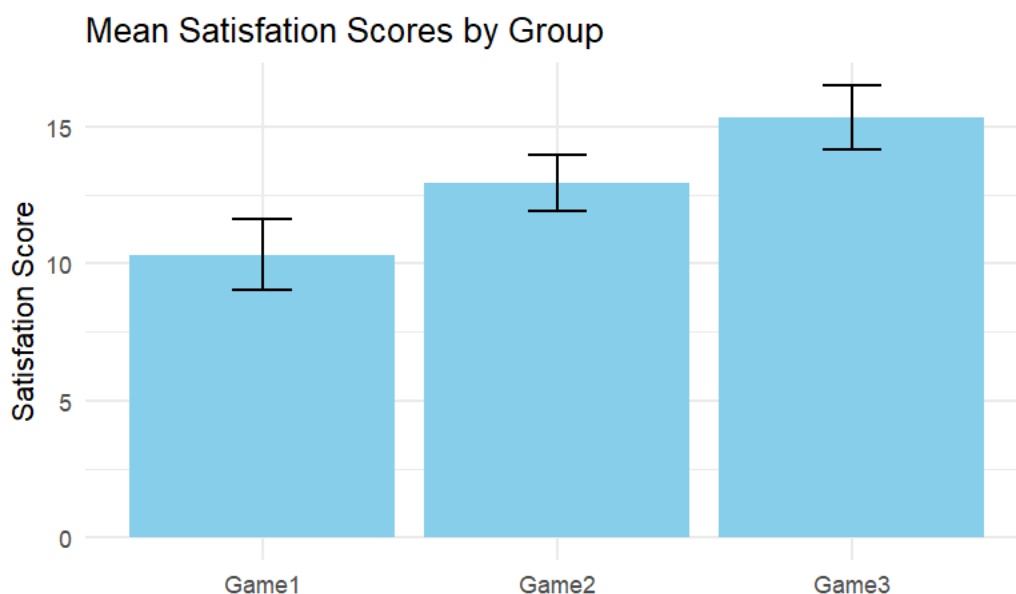
Table 1 summarizes the insights that we added from Smily Game to make the game attractive and still analytical in Game. Each row represents our consideration and our action plans that we applied in the game development.

Table 1: Our lesson learns from Smiley Model to improve lot sizing simulation game.

Learning Design		Game design elements		Motivational factors
Learning goals	Learning process	Our action plans	Rules	Individual characteristics
Soft skill development	Communication and coordination	Chat system	Narrative	Social relations
Evaluation	Team leaderboard	Team competition	Feedback	Competence and competition
Hard skill development	Individual leaderboard	Individual analytics	Choice	Curiosity

The ANOVA test shows that there is a highly statistically significant difference in participant satisfaction among the three games ($F(2, 116) = 17.55, P < 0.001$). This indicates that the means of satisfaction are not all equal across the groups, and at least one group has a mean that is significantly different from the others. As it is shown in Figure 1, The post-hoc Tukey's test results show significant differences in satisfaction scores between all pairs of games. Specifically, Game 2 ($M=12.93, SD=3.50$) has a significantly higher mean ($p = 0.0031$) satisfaction score than Game 1 ($M=10.31, SD=3.82$), Game 3 ($M=15.31, SD=3.36$) has a significantly higher mean satisfaction score than Game 1 ($p < 0.0001$), and Game 3 also has a significantly higher mean satisfaction score than Game 2 ($p = 0.0092$).

Figure 2: Comparison of participants' satisfaction in different game settings



The Tukey post-hoc test results show that Game 2 has a significantly higher mean score than Game1, and Game3 has a significantly lower mean score than Game 1, with 95% confidence intervals not including zero and p-values of 0.0092072 and 0.0031215, respectively. The next step will be the comparison of individual characteristics of the players by the roles that they have been selected. We would compare the individual characteristics of the players during Game 3.

The ANOVA test shows that there is a statistically significant difference in the need for cognition scores among the three roles (Manager, Buyer, and Planner) ($F(2, 32) = 3.744, p = 0.0346$). This indicates that the means of the dependent variable are not all equal across the roles, and at least one role has a mean that is significantly different from the others. We ran post-hoc Tukey test. However, none of the role comparisons show a statistically significant difference in the mean need for cognition scores at the 0.05 level, although the Planner vs. Buyer comparison is marginally significant.

The ANOVA test shows that there is no statistically significant difference in self-efficacy among the three roles (Manager, Buyer, and Planner) ($F(2, 32) = 0.562, p = 0.575$). This indicates that the means of the dependent variable are approximately equal across the roles, and any observed differences are likely due to random variation rather than a true effect of the role.

The ANOVA test shows that there is a statistically significant difference in financial risk-taking among the three roles (Manager, Buyer, and Planner) ($F(2, 32) = 3.953, p = 0.0292$). We ran Tukey test. However, none of the role comparisons show a statistically significant difference in the mean financial risk-taking scores at the 0.05 level, although the Planner vs. Buyer comparison is marginally significant.

CONCLUSION

In this study, the efficacy of gamification in teaching supply chain management is significantly enhanced when individual student characteristics are considered and integrated into the game design. This paper has underscored the pivotal role of individual differences, such as the need for cognition (Cacioppo & Petty, 1982), self-efficacy (Bandura, 1997), and financial risk-taking, in shaping the educational outcomes of gamified learning environments. As demonstrated, students with a high need for cognition find intellectually challenging games more rewarding, which suggests that gamification strategies should include levels of complexity and problem-solving that cater to this need (Cacioppo & Petty, 1982). Similarly, the influence of self-efficacy (Bandura, 1997) on student engagement and motivation in gamified learning underscores the necessity of designing games that provide immediate feedback and realistic challenges to foster a sense of achievement and competence. The differentiated impact of these individual characteristics on student learning outcomes accentuates the importance of adopting a more nuanced and personalized approach to gamification in supply chain management education.

The adaptability of educational games, allowing for complexity modulation based on individual skills and characteristics, ensures that students are neither overwhelmed nor underchallenged, facilitating an optimal learning curve (Deci & Ryan, 2000). In light of these findings, it is imperative for educators and game designers to meticulously consider these individual characteristic factors when developing gamified learning solutions for supply chain management. By doing so, the educational potential of gamification can be fully realized, ensuring that students are not only engaged and motivated but also effectively learning the complex and dynamic principles of supply chain management.

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DECISION SCIENCES INSTITUTE
Graduate Students' AI Use

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ABSTRACT

. The Deloitte report (2024) states that AI is a multiplier. It is a revolution. Everyone must prepare for the future of AI. Research on learning with ChatGPT might help students become not just users of AI technologies but also 'informed, critical users' of these technologies and prepare them for a future in which AI technologies are part of professional and everyday life.

In this study, our research purpose is to explore students' behavior and attitudes toward AI tools. We used a survey method to assess graduate students' AI use and their attitudes toward AI use. Our study made a timely contribution to the rapid adoption of AI in the educational sector. Such findings could help us understand students' preferences and improve our teaching accordingly.

KEYWORDS: Artificial Intelligence, Technology Adoption, Students, ChatGPT

INTRODUCTION

According to CBS, 56% of students use AI to do their assignments (Rex, 2023). Students use AI at a higher rate than teachers, according to Inside HigherED (Coffey, n.d.). The pattern seems to indicate that AI will be used more frequently. Thus, students should comprehend how to use AI appropriately in both their academic and professional lives. As teachers, we are aware of the shifts in our pupils' attitudes and behaviors. Students that use AI to produce their emails are sending us more of them. In light of the current disruptions in education institutions, it is our responsibility to teach students not just technical skills and knowledge but also ethical principles of technology.

With the ongoing digital education trend, learning is increasingly online, and students need to be ready for that. By understanding how students use AI and learning about the use of AI such as ChatGPT, we can design courses for improved learning outcomes, including teaching students how to develop critical thinking and academic integrity – and that might inform educators and policymakers about developing approaches to ChatGPT and other AI in education that support students and minimize its harms. The Deloitte report (2024) states that AI is a multiplier. It is a revolution. Everyone must prepare for the future of AI. Research on learning with ChatGPT might help students become not just users of AI technologies but also 'informed, critical users'

of these technologies and prepare them for a future in which AI technologies are part of professional and everyday life.

In this study, our research purpose is to explore students' behavior and attitudes toward AI tools. We used a survey method to assess graduate students' AI use and their attitudes toward AI use. Our study made a timely contribution to the rapid adoption of AI in the educational sector. Such findings could help us understand students' preferences and improve our teaching accordingly.

LITERATURE REVIEW

Our literature review focuses on technology adoption and AI guidelines. We explore existing literature, scholarly articles, and reports to analyze the guidelines governing artificial intelligence.

The Technology Acceptance Model (TAM) posits two variables: users' perception of technology usefulness and their perception of its ease of use, which predicts their intention to adopt the technology. The particularity of this model is that it is based on the perceptions of the potential user (Davis, 1989). Many studies have extended the original TAM model, validated, and applied TAM in various contexts. For example, Teo and Noyes (2011) added enjoyment as a predictor to the model, and conducted a structural equation modeling using a sample of pre-service teachers. They found that enjoyment is positively associated with ease of use, usefulness, attitudes toward the technology, and intention to use.

Ha and Stoel (2009) integrates e-shopping quality, enjoyment and trust with technology acceptance model (TAM) to examine consumer acceptance of e-shopping using a sample of college students. Structural equation modelling indicated that e-shopping quality determined perceived usefulness, trust, and enjoyment, which further influenced consumers' attitude toward e-shopping. Perceived usefulness and attitude toward e-shopping influenced the intention to shop online while perceived ease of use did not influence attitude toward e-shopping. Shopping enjoyment and trust played major roles in consumers' adoption of e-shopping. However, this study did not confirm the relationship between ease of use and attitude. (Ha & Stoel, 2009)

Recently, Wang et al. (2020) applied TAM to the ride-sharing in the transportation industry. They examined determinants of consumers' intention to use ride-sharing services that are important to promote ride-sharing services. The extended technology acceptance model was used as a theoretical research model. This extension is implemented by adding three new constructs: personal innovativeness, environmental awareness, and perceived risk. The empirical results reveal that personal innovativeness, environmental awareness, and perceived usefulness are positively related to the consumers' intention to use ride-sharing services, while perceived risk is negatively related to the intention and perceived usefulness. Again, this study also found that the perceived ease of use has no significant effect on intention to use ride-sharing services. Personal innovativeness is positively related to perceived usefulness and perceived ease of use and negatively related to perceived risk. (Wang et al., 2020).

ChatGPT is a significant innovation in mankind history. It has intuitive interface. It is easy to use. Students can get a quick summary of topics, and use it to understand course content. It offers students 'a new level of interactivity, access to information and learning support (Zhang & Aslan, 2021). Damiano et al. (2023) conducted an early study of ChatGPT use. Students reported that they would not use the technology for plagiarising, but did think that others would. In response

to a question asking students to rate the accuracy of ChatGPT's output, more than half chose the wrong output as correct/somewhat correct or 'don't know' which was correct or incorrect (Damiano et al., 2024).

Choudhury and Shamszare (2023) investigated user trust on their use of ChatGPT. They found that trust is of utmost importance to users' adoption of ChatGPT. As such, relying on ChatGPT for health-related queries can potentially lead to inaccurate information and misinformation, which can risk a person's health. Instead, more attention should be devoted to improving. They warn users not to blindly trust artificial intelligence (AI) chatbots (like ChatGPT) and also called for collaborative efforts among developers, subject matter experts, and human factors researchers (Choudhury & Shamszare, 2023).

METHODS

We designed an online survey asking students' use of ChatGPT. The study was approved by the Institutional Review Board. We used our graduate students as our study participants. A total of 25 graduate students participated in the survey. Among which 75% were males, 20% were females, and 45% preferred not to answer. Regarding age, 25% are under 25, 55% are 25-34, 20% are 35-44. In terms of work experience, three students are in school and do not have any work experience; the mean work years are 6.7 years, and the median is 6.5 years. When asked about the hours worked each week, the mean is 37.5 hours, and the median is 40. Our student population in the online program consists of the majority of working professionals; 85% of them work full-time. Their job titles include data analysts, software developer, clinical research coordinator, advisor, engineer, pharmacist, bodily injury claims adjuster, product manager, financial analyst. Our students represent a diverse industry sector.

RESULTS

We conducted a descriptive analysis using SPSS on the following question: Table 1 below shows the questions and responses. As shown in Table 2, 32.2% agree or somewhat agree with the statement that ChatGPT is their study partner; 7.14% students somewhat agree with the statement - ChatGPT is my go-to platform for schoolwork; 32.1% either agree or somewhat agree with the statement - ChatGPT helps me be productive when completing schoolwork.; 35.7% of the students agree or somewhat agree with the statement - I worry that ChatGPT makes up answers for me.

Questions	Responses	Percent
ChatGPT is my study partner.	Strongly disagree	21.43
	Disagree	28.57
	Neither agree nor disagree	17.86
	Somewhat agree	28.57
	Agree	3.57
ChatGPT is my go-to platform for schoolwork.	Strongly disagree	25.00
	Disagree	46.43
	Somewhat disagree	7.14
	Neither agree nor disagree	14.29

	Somewhat agree	7.14
ChatGPT helps me be productive when completing schoolwork.	Disagree	17.86
	Somewhat disagree	21.43
	Neither agree nor disagree	10.71
	Somewhat agree	25.00
	Agree	7.14
I worry that ChatGPT makes up answers for me.	Strongly disagree	7.14
	Disagree	10.71
	Somewhat disagree	14.29
	Neither agree nor disagree	32.14
	Somewhat agree	28.57
	Strongly agree	7.14

DISCUSSION

The descriptive analysis presented in Table 1 provides insightful data into students' perceptions of ChatGPT as a study tool and its impact on their academic productivity and their worry about inaccurate answers ChatGPT provides.

The item "ChatGPT is my study partner" showed a relatively polarised response to disagree with the statement, with 50% of the respondents combined (21.43% strongly disagree and 28.57% disagree) thinking that ChatGPT is not their study partner. A notable proportion of students (32.14%) somewhat agree or agree with the statement, so while ChatGPT is not a universally accepted study partner, to a significant sub-set of the student body, ChatGPT is a study partner. When the statement "ChatGPT is my partner in studying for school" was considered, responses were more polarised towards disagree. A combined 71.43% of respondents either strongly disagree (25%), disagree (46.43%) or somewhat disagree (7.14%) with the statement. Overall, students are reluctant to depend on ChatGPT for the completion of their schoolwork. This might be due to the lack of awareness of the potential of Chat GPT to generate schoolwork output or skepticism about its reliability for schoolwork. The response to the statement "ChatGPT helps me be productive when completing schoolwork" was clearly more mixed. Here, 32.14% disagreed (17.86% disagree and 14.28% somewhat disagree) that ChatGPT helps them be productive when completing schoolwork, whereas another one-third agree with the statement. The final statement "I worry that ChatGPT makes up answers for me" displayed evenly distributed responses across disagree, neutral, and agree. Here, 35.71% felt that they worry that ChatGPT makes up answers for them (28.57% somewhat agree and 7.14% strongly agree). However, the majority of responses neither agree nor disagree (32.14%), which means the largest single category of response showed the statement in neutral term. This implies that students do not trust ChatGPT answers blindly. As an academia, this is comforting to know. However, for students who trust AI tools, we need to warn them the best practice is to double-check and fact-check results.

CONCLUSIONS

As the inevitability of AI integration into our daily existence becomes reality, we conducted this study and explored the landscape of AI use by students and their attitudes towards these tools. Our findings show that students are still in the early stage of adoption of ChatGPT. Our data suggests an interest in using such a tool purposefully but also a hesitation of using such a tool. As AI is quickly evolving, it's possible students use of AI will increase rapidly next year and their attitudes and perceptions will change. It's interesting to see how the trends change in the long run. We will continue this stream of research.

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Introduction to an Adaptive Hybrid In-Class Exercise for a Quantitative Business Course

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ABSTRACT

This paper introduces an adaptive in-class exercise which is the hybrid between typical quizzes and practice problem reviews in a quantitative business course. To incorporate the variability in the speed of processing quantitative contents, it is diversified into three different types and implemented based on the progress of students in each class: Original form (on-pace progress), Demonstrative form (falling behind the progress), and Instructive form (major difficulties). Then the corresponding assignment is given to students to finalize the learning outcomes. It also plays a role of evaluating the participation of students for the class. The results and implications are discussed.

KEYWORDS: Quantitative business course, In-class exercise, Adaptive teaching activity, Team-based learning, Active learning

INTRODUCTION

Teaching quantitative contents to business students is always a challenge, as the author experienced it throughout the fifteen years of career in three different universities with different environments – different countries (U.S. and South Korea), different institution types (Research-One (R1) universities and Teaching university), and different class sizes (50-80 per class and 5-30 per class). Ganyaupfu (2013) states that subpar academic achievements in quantitative business courses in higher institutions has remained as one of the reasons for student dropouts, low graduate point averages and reduced graduate throughput. Lightner & Lightner-Laws (2016) shows that the proportion of students passing quantitative business courses is less than the proportion from quantitative business courses. Utzl & Smibert (2017) even claims that teaching quantitative courses are far more likely to have difficulties in receiving tenure, promotion, and/or merit pay when the instructors are evaluated in general criteria.

The key obstacles of interest in this paper for the instructor to facilitate learning in quantitative business courses are the fear of being wrong and the variability of students in terms of the speed of processing quantitative contents. To mitigate these issues, a new pedagogical method, which is an adaptive, hybrid in-class exercise that is between typical quizzes and practice problem reviews, is presented. The focus of the proposed activity in terms of pedagogical dimensions are the teaching style and the assessment method, which are major factors that affect the academic performance of students (Ganyaupfu, 2013; Yousef, 2017). It is a free-discussion, group-based, active learning activity without the pressure of getting poor grades. It also works as an evaluation method for student participation for the class.

THE ORIGINAL SETTINGS

Group Formation: In this activity, first the students need to form their groups of 3-4 people for entire semester. The students have two options – form their own group or to be randomly

assigned to a group. These options work for both the students who are eager to work with friends and the ones who do not know anyone in the class.

Activity Type: It is a type of an open-book, open-notes quiz where the students can freely use the materials and discuss with their group members to work for drawing the solutions for the given questions.

Grading: If the answer is 100% correct, a 10 out of 10 point is given. If not, the remaining answers from the groups are compared, not graded, and the grades are given between 9 and 9.5. It means that once a student participates, he or she does not have to be pressured to get a higher grade. But if a student does not participate, 0 grade is given so that the student keeps in mind the importance of participation. Because it is included in the final course grade, I find the students work hard but freely without pressure in every exercise.

Process: After the questions are given, the groups have 35-40 minutes finish and submit the answer sets. Then the solutions are given on the board immediately.

Observations: It can be observed that the students are having free discussions with smiles and enthusiasms. When the solutions are given, it makes the students to say either “Yes” or “Ahhhaaa” with giggles, which means they actually processed the question by themselves regardless of getting it right or wrong. This is the time when the real learning experience occurs. Thanks to the fact that they can still get 90% or more, finding out that their answers are wrong does not become a negative experience but a positive learning experience.

Extending the Learning Outcomes: At the end of each exercise, the individual assignment that is the extension of what the students learned in the exercise is given to the students right after the “Ahhhaaa” experience, which gives the students the opportunities to apply and finalize the learning outcomes.

THE DIVERSIFICATION FOR ADAPTABILITY

After spending a semester at the current institution, which is a teaching university, it was found that the variability in the speed of processing quantitative contents for the students was significantly higher than the variability of previous two universities that are R1 institutions with more emphasis on the analytical capabilities of business students in admission process. To respond to the new challenge, the exercise was diversified into three different types and implemented based on the progress of students in each class.

- In-class Exercise - Original form (when the progress is on pace with the plan): As described as above.
- In-class Exercise - Demonstrative form (when the students are a little behind the learning curve): Before the teams begin their work, the review of the tasks required given to them. A 10 out 10 point is guaranteed as long as they submit their answers on time. If they cannot finish on time, a grade between 9 and 9.5 is given by comparing the completeness of the answers.
- In-class Exercise - Instructive form (when a large portion of the students are having difficulties in understanding the process): The exercise begins with the teams work themselves, but the instructor is to walk around and work with each team in order to verify and validate each step and guide them to the right answer. The goal is helping all the teams finish the exercise on time as much as possible. When they cannot finish, office hours are utilized, and the submission

becomes an additional assignment. All groups are guaranteed to get a 10 out of 10 point as long as they participate and finish the exercise.

The adaptation of different types is determined based on the observations from the lectures that precede each exercise. The signals are detected especially when the example questions are presented and explained during the lectures.

CURRENT RESULTS

The proposed exercise is still an ongoing project with the results of two semesters where it was implemented for a course named “Management of Production and Operations”. The following is the summary of the results:

- The learning outcome question – the knowledge in the subject after taking the course (Between 1 and 5 with 1 being “very low” and 5 being “very high”)
 - Before the implementation: 4.10
 - After the implementation: 4.45
- The overall course evaluation (Between 1 and 5 with 1 being “Poor” and 5 being “Excellent”)
 - Before the implementation: 4.64
 - After the implementation: 4.72
- About 73% of the students mentioned that the proposed exercise was the element of the course that helped them the most in improving their learning.

CONCLUSIONS

In this paper, a new, adaptive pedagogical method which is a hybrid in-class exercise between typical quizzes and practice problem reviews is presented. In addition to its benefits from the active-learning and group-based learning nature, it provides an effective platform that can help students engage and learn quantitative contents without the stress and pressure of trying not to make mistakes. Also, the adaptation of three different types of processes based on the student progress gives the instructor the flexibility to deal with the variability of students in terms of the speed of processing quantitative contents. The outcome was very positive and showed the potentials of meaningful improvement in learning outcome and teaching effectiveness in a quantitative business course. Since the results have been drawn from only one semester, we need more future analysis based on more trials.

This method is still an ongoing project. The most challenging issue faced during the implementation was the limitation of my availability to help multiple groups simultaneously during the “Instructive Form” of the exercise. To resolve the issue and as the next step of improving the method, a new teaching partnership program called “Student as Partner (SaP)”, where a student becomes the “teaching partner”, not a teaching assistant, and plays a bigger role with a student perspective, has been integrated with the proposed method.

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Student Engagement in Higher Education – Lessons Learned During the Pandemic

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ABSTRACT

This paper examines the challenges to student engagement that occurred during the 2020 transition to emergency remote learning, as well as solutions for improving student engagement that were developed during this period.

KEYWORDS: Remote Education. Student Engagement.

INTRODUCTION

The onset of the COVID-19 pandemic in the spring of 2020 required schools, colleges, and universities worldwide to transition to some form of remote education. (Foss, 2020) Prior to the pandemic, almost a third of college students in the United States had enrolled in at least one online course, often mixed in with in-person courses. At the same time, many instructors had already developed online teaching skills. (Gallagher & Palmer, 2020, Nguyen, 2015) However, online learning was not the rule until the pandemic made it so. In this transition, instructors new to online education were required to quickly adopt new teaching techniques and technology skills, in the middle of an academic term and without a substantial amount of time to prepare. (Means & Neisler, 2020; Schultz & DeMers, 2020)

Following the 2020 transition to online education, the term “Remote Learning” became linked the concept to the pandemic response. For instance, Hodges et al (2020) refer to the pandemic-related move to online education as “emergency remote teaching” because of the hurried nature of it. Traditionally, they argue, online instruction has been carefully planned and designed, resulting in learning materials, student activities, and assessments of high quality. For many courses that transitioned to virtual mode in 2020, the time to do so thoughtfully was not available, while campus support resources were not always sufficient. (Nordmann et al, 2020)

As a result, early assessments of the effectiveness of educational efforts at university levels were mixed; some instructors and courses fared better during this time than others. (Chattaraj & Vijayaraghavan, 2021) These early outcomes are not surprising. What occurred was essentially a massive pedagogical experiment without the development of a carefully constructed experimental design, an evaluation by an Institutional Review Board, or the use of a control group. (Zimmerman, 2020)

Fortunately, a substantial amount of data gathering occurred after the fact as educators shared their experiences, best practices, informal assessments, and formal research outcomes. Such data gathering will be essential in assessing the consequences of the remote learning that took place during the pandemic, in particular its impact on student engagement, which is the subject of this paper.

IMPACTS OF REMOTE LEARNING ON STUDENT ENGAGEMENT

Educators have long known that student attendance and submission of assignments are not sufficient for achieving student success. For students to do well, they need to be actively involved with a course, its materials, and its objectives. This active interest in the learning process motivates students to participate in course activities, helping them to excel even in challenging tasks. This involvement is commonly referred to as student engagement. Past research has shown student engagement to affect what students do, feel, and think. This reaches well beyond the confines of a specific course, as engagement can be strengthened by student participation in faculty research, professional development activities, and on-campus organizations and events. Research has shown that low student engagement impacts student achievement, boredom, and dropout rate. (Groccia, 2018)

The sudden transition to remote learning directly impacted student engagement with both their coursework and their educational institutions. After all, the lockdown did not only affect courses, but also shut down campus gatherings, events, and organizations. Lacking the immediate support of a campus environment, some students felt helpless when confronted with course challenges or technical difficulties. (Schultz & DeMers, 2020) It was not surprising that quickly following the transition to remote learning, educators started to report increased student isolation, loneliness, and disconnection from their coursework. (Fox et al, 2020; Hehir et al, 2021)

Before the pandemic, students more dependent on the social environment provided by in-person learning could deliberately opt to enroll in on-campus courses. Following the 2020 campus closures, participation in online courses was no longer voluntary. The physical separation that the pandemic forced onto students resulted in a reduced student engagement with their education. Students were found to be less motivated to work and even more likely to cheat to complete assignments. The less frequent direct communications with their instructors added to student disengagement. (Parker et al, 2021)

It has long been known that student self-motivation is an important factor in the success of online education. Students in any online learning context have a great amount of autonomy, as many online courses lack the familiar rhythm of regular class sessions. This requires online students to take on greater responsibility for their learning. The reduction in student engagement found in 2020 shows that not all students had the inner motivation needed to succeed at online learning. (Goncalves et al, 2020)

A 2020 survey found that students were less satisfied with their courses after the move to remote instruction. When pressed for detail, students were quite pleased with the instructor's preparation and the quality of course content but felt that their overall learning had decreased because they had fewer opportunities to collaborate with other students and expressed less interest in course content. In addition, lack of self-motivation was reported as a significant barrier to online course participation. These issues also point to reduced student engagement. (Means & Neisler, 2020)

The use of online learning need not automatically result in reduced student engagement. There are ways to use communications technologies and networks to promote connectedness and engagement with students. Using a variety of digital communications technologies, students can interact more intensely and build better relationships with fellow students and instructors

(Groccia, 2018; Hehir et al, 2021) Suggestions for improving student engagement are discussed next.

BUILDING STUDENT ENGAGEMENT TO ENHANCE STUDENT LEARNING

Following the transition to emergency remote learning, educational institutions initially focused on providing students with technology and bandwidth to help reduce the barriers to access to education. (Heitz et al, 2020) Meanwhile, instructors focused on improved communications, remote learning pedagogy, and community building, aiming to improve student engagement and learning. (Fox et al, 2020)

Instructor Presence

The feelings of disconnection and reduced communications experienced by students required instructors to adjust traditional communications practices to meet students' needs. Students needed guidance on how to become effective remote learners. Instructors would assist students as they built the digital skills needed to navigate online learning environments, and then hold them accountable for their progress. (Katz et al, 2021; Parker et al, 2021)

A straightforward way to encourage student engagement with the course is to state expectations upfront. When are the students expected to participate in specific course activities? How much time can they expect to spend on these? When should course content be viewed and assignments be turned in? Providing clear expectations at the outset provides students with structure and helps them develop regular habits for participation. Instructors should subsequently monitor student attendance and participation to identify and aid those students struggling in the course. (Nordmann et al, 2020)

Remote learning also requires the instructor to have a strong personal presence. The instructor's voice (both literal and figurative) should resonate in the online lessons and course activities. Effective and frequent communication with students has a positive effect on student learning. The instructor should be approachable to students and offer quick and supportive feedback to questions and requests for assistance. Individualized messages from the instructor to the students to assess how well they are doing have been found to have a positive impact on student satisfaction. This then allows students who struggle to reach out with questions or need for support. When students perceive the support of a genuine person, it can strengthen their engagement. Using this "pedagogy of care" to coach students through challenges promotes better learning outcomes. (Hehir et al, 2021; Katz et al, 2021; Means & Neisler, 2020; Schultz & DeMers, 2020)

Remote Learning Pedagogy

Following the transition to remote learning instructors began to explore alternatives to the traditional lecture format to keep students interested and involved. A more varied and active approach to learning could better engage students by breaking up online class time into a variety of activities, enhance communications and collaboration among students, and take advantage of today's technologies and applications.

Van Wyk et al suggest the adoption of micro-learning to promote student engagement. This approach uses small and highly focused learning units or activities. It is well known that exposing students to large swaths of content (either text or video) involves very little interaction,

resulting in reduced retention. In micro-learning, short lessons (such as short texts or videos) and activities encourage student curiosity, allow for hands-on and collaborative exercises, and in the process build student engagement with the subject area. Sequencing and interconnecting these lessons and activities builds up larger learning content over time. For assignments and activities, the use of tools like discussion boards, social networks, and wikis allows students to communicate and collaborate as they explore and learn. (Means & Neisler, 2020; Van Wyk et al, 2020)

The most common pedagogical approach adopted to implement this learning style was the flipped classroom method. Building on this method (in which students watch course content online as homework, freeing up the class session for activities), in a “fully online flipped classroom,” in-person class time is replaced by video conferencing sessions. The use of in-session polls, breakout rooms, text chat, multimedia bulletin boards, and online discussions implements micro-learning concepts. (Hew et al, 2020)

Building Communities for Student Empowerment

As mentioned, being part of a community is an important aspect of student engagement. Traditional campus life offers students a variety of communities to engage with: student clubs, professional organizations, fraternities and sororities, athletic teams, etc. When the pandemic shutdown caused many campus communities to either go on hiatus or host only virtual events, the academic courses became more prominent communities for students to belong to. Synchronous discussions using video conferencing, synchronous discussions, team activities, and online student presentations with follow-up discussions are sound ways for students to interact and learn. (Soria et al, 2020) Research suggests that such interactions can help students overcome feelings of distance and isolation, as well as aid in improving learning outcomes. (Schultz & DeMers, 2020) Simply put: “The success of the online pivot will not be determined by the quality of video content but by the strength of the community that emerges from the other side.” (Nordmann et al, 2020)

Such course-based communities are structured differently from traditional classroom setting instructors are accustomed to. Instructors would instead become facilitators, supporting students as they explore course contents. The students take a more active role in their learning process. (Fox et al, 2020) Providing students with a choice of activities, resources, and methods of participation increases engagement and subsequent learning. Such flexibility of participation gives students agency and accommodates a broader range of student profiles. (Langford & Damşa, 2020)

The use of learner-driven assignments – in which students explore topics they are interested in – is known to strengthen learner agency. Formative assessments and active learning activities are emphasized in such an approach. For example, providing the students with the opportunity to investigate a topic within the bounds of a course and subsequently reporting their findings is a learner-driving approach to achieving the educational goals of a course. (Rapanta et al, 2021; Whittle et al, 2020)

Course-based communities can also be enhanced by the use of peer teaching. Peer teachers are students who have previously mastered a specific course, and who are subsequently recruited to work with students in small-group activities or one-on-one mentoring. Peer teachers tend to be more available to students than a single instructor, enhancing interaction about the

course materials. Even when such interactions take place online, these connections help build a sense of community and strengthen student engagement. (Jeong et al, 2020)

Finally, considering that campus life is an important part of the university experience, efforts were made to offer virtual spaces to connect students outside of their online classrooms. Luong & Arnold (2020) encourage the development of “a digitized safe space, established for education, within which students have a sense of belonging.” As an example, the University of Florida developed a mobile app which provides a virtual “student plaza” in which students can organize study groups and meet with faculty, staff, and academic advisors. (Heitz et al, 2020; University of Florida, 2022)

CONCLUSION: MOVING FORWARD

From the 2020 experience with emergency remote teaching, we have learned that failure to engage students effectively has resulted in sub-optimal learning for many students. Yet at the same time, instructors have now obtained valuable experience teaching online. While initial efforts at remote learning may have been hurried and imperfect, over time instructors shared their experiences and insights to improve remote teaching efforts. The evaluation of these pandemic-era experiences has the potential to uncover innovative approaches and best practices for educators to follow to enhance student engagement. (Appolloni et al, 2021)

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