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GENERATIVE AI INSIDE THE EDUCATIONAL DESIGN LIFE CYCLE: A CASE STUDY IN PEAK TEACHING

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A foundational principle of student-centered learning is that effective instruction must meet students where they are. Yet delivering truly differentiated instruction at scale has remained elusive—the logistical burden of creating multiple learning pathways often exceeds what a single instructor can manage. This study examines whether AI-assisted course design can make differentiated pathways practical and effective in an introductory Business Law course. Results demonstrate that scaffolded pathways significantly improved learning gains for underprepared students ($\beta = 23.69$, $p < .001$), while a gamified alternative produced a modest benefit compared to historical instruction ($d = 0.26$). Critically, sentiment analysis of student feedback revealed friction points that informed targeted improvements, demonstrating a complete action research cycle enabled by AI tools at each stage.

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INTRODUCTION

Well-executed instructional design incorporates a series of inter-related principles including the idea of alignment of course objectives, activities, and assessments; reflective teaching practices that encourage faculty to reflect on learning experiences and integrate student feedback into design changes; and universal design principles that maximize classroom inclusion of learners of varying levels of readiness and backgrounds.

Backward Design or Constructive Alignment (BD) is a framework for ensuring course alignment by beginning with the end in mind in the course design.¹ Biggs discusses this idea further with his concept of “constructive alignment,” where a tight coherence is intentionally

created between the learning objectives, teaching methods, and the assessment activities of the course.ⁱⁱ

The Analyze, Design, Develop, Implement, and Evaluate (ADDIE) waterfall approach to course design, and more recent rapid-development adaptations of ADDIE, embrace the general idea that course design should be iterative, using evidence and analysis to guide subsequent changes to course design and delivery.ⁱⁱⁱ The idea that professors should reflect on their teaching and incorporate design changes using evidence-based methods is discussed by Donald Schön in “The Reflective Practitioner,” in which he introduces the idea that professionals engage in “reflection-in-action” as researchers that create new testable theories in the context of a practice problem.^{iv}

Universal Design for Learning (UDL) embraces three principles for student success: provide students with multiple means of success, multiple means of representation, and multiple means of action (the why, what, and how of learning), giving students choices in their learning experiences to support equitable opportunities for learning without reducing academic standards.^v

These concepts have their foundation in Bandura’s theory of self-efficacy in learning, including mastery experiences, vicarious experiences, social persuasion, and affective states,^{vi} as discussed by Schettig in the context of modular design to promote success and engagement in an engineering graphics course.^{vii}

However, putting these theories into practice in course design comes with numerous challenges for the instructor, primarily related to time and instructional capacity. For example, creating varying learning pathways for students as part of a UDL approach where each pathway is Blooms-appropriate for specific learners requires the creation by hand of multiple versions of a course activity or assignment.^{viii ix x xi} Such manual work by subject matter experts is time-intensive and does not lend itself to rapid development iterations.

Recent advances in generative Artificial Intelligence (genAI) such as Claude.AI and ChatGPT, offer a potential solution. Large language models can assist instructors in rapidly developing differentiated content: scaffolded activities targeting lower-level Bloom’s taxonomy objectives (identify, comprehend) for students who need foundational reinforcement, alongside higher-level activities (apply, analyze) for students ready to extend their learning. Beyond content creation, AI tools can assist with outcome measurement and qualitative feedback analysis, enabling a continuous improvement cycle that would be impractical through traditional methods alone.

Below, I discuss a method for the effective integration of genAI into the full course design cycle, and the subsequent measurable improvements in learning for students participating in the resulting educational experience. This methodology represents “Peak Teaching,” made practical by the supervised application of genAI technologies, guided by human expertise and knowledge of teaching and the substantive course materials.

THE INTERVENTION: THREE LEARNING PATHWAYS

Students in an introductory Business Law course were offered three pathways through the course content, each designed to accommodate different learning needs and preferences. GenAI was used extensively in the development of course activities for all learning pathways.

TRADITIONAL PATHWAY ASSIGNMENT VIA PRE-TESTS

Students opting for a traditional path completed module-level pre-tests assessing readiness for each unit's content. Students scoring seventy percent or above on most module pre-tests were assigned to the Standard Pathway (Pathway 1), receiving activities emphasizing application and analysis. Students scoring below this threshold were assigned to the Scaffolded Pathway (Pathway 2), receiving additional activities targeting identification and comprehension before progressing to higher-order tasks. This adaptive model operationalizes Vygotsky's zone of proximal development.^{xii} rather than presenting uniform content, the course structure identifies each student's current capability and provides appropriately challenging material using Bloom's Taxonomy as a guide to the content development.^{xiii}

THE GAMIFIED ALTERNATIVE: LAWYER'S QUEST

Students that elected a gamified version of the course were invited to engage with course content through Lawyer's Quest, an educational game I co-developed with genAI. Students on this pathway did not take module pre-tests; instead, they completed quests that covered equivalent content through game-based scenarios. This pathway was designed for students who might benefit from increased engagement and autonomy in their learning approach.

QUANTITATIVE RESULTS

PRIMARY ANALYSIS: PRE-TEST TO EXAM GAINS

I initially examined whether scaffolded instruction improved learning gains for underprepared students. I calculated gain scores as exam score minus pre-test average for each student-unit observation. I utilized a mixed-effects regression model to account for repeated measures within students ($n = 216$ observations across 79 students).

Students on the Scaffolded Pathway demonstrated significantly greater gains than students on the Standard Pathway ($\beta = 23.69$, $SE = 3.46$, $t(216) = 6.857$, $p < .001$). On average, Scaffolded students improved by approximately 12 points from pre-test to exam, while Standard students declined by approximately 13 points—a differential of 25 points favoring the scaffolded approach.

TABLE 1: PRE-TEST TO EXAM GAINS BY PATHWAY AND UNIT

Pathway	Unit	Avg Pre-Test	Avg Exam	Gain
Standard	1	76.6	76.6	+0.0
Standard	2	91.4	68.3	-23.1
Standard	3	94.3	79.2	-15.1
Scaffolded	1	53.7	68.2	+14.5
Scaffolded	2	56.0	62.8	+6.8
Scaffolded	3	52.2	62.8	+10.6

Note: Scaffolded pathway shows consistent positive gains across all units.

SECONDARY ANALYSIS: PATHWAY COMPARISONS ON RAW EXAM SCORES

Because gamified students did not take pre-tests, gain scores could not be computed for this group. I therefore conducted a secondary analysis by comparing raw exam performance across all three current pathways and historical instruction (prior semesters 2023-2025 without differentiated pathways).

TABLE 2: AVERAGE EXAM SCORES BY PATHWAY AND UNIT

Group	Unit 1	Unit 2	Unit 3
Standard (n=171)	76.6	68.3	79.2
Gamified (n=45)	71.2	63.5	74.3
Scaffolded (n=40)	68.2	62.8	62.8
Historical (n=714)	63.8	64.4	72.7

Gamified students—who self-selected into this pathway without pre-screening for prior achievement—averaged approximately seventy percent on exams across units, landing solidly in the C range. This is notable because they performed comparably to the overall course population (and a bit above the undifferentiated historical observations) despite choosing an unconventional learning modality. Compared to historical instruction, gamified students showed a small positive effect ($d = 0.26$, 95% CI $[-0.04, 0.57]$, $p = .14$) that did not reach statistical significance, likely due to limited sample size.

QUALITATIVE FEEDBACK: IDENTIFYING FRICTION POINTS

While quantitative outcomes were encouraging, the semester also saw higher-than-typical attrition: sixteen students failed or withdrew from the course, compared to lower numbers in prior semesters. To understand this pattern, I co-developed with genAI a sentiment analysis pipeline that I applied to student feedback collected throughout the semester using anonymous exit tickets at the conclusion of each learning module, along with all student emails received from business law sections. The Python script was then able to interpret and categorize student feedback into two general categories: (a) friction for students in accessing the learning experience, and (b) friction for students concerning the course content itself.

As to the former, the analysis identified two course design issues. First, students reported uncertainty about which activities they were supposed to complete, how pathways were assigned, and what the pre-test scores meant for their learning trajectory. Second, I assigned all students to initially complete a quest in Lawyer's Quest before deciding whether to gamify the course experience for the semester. While I had provided written instructions, a walkthrough video of how to play the game, and a subsequent live stream for students that wanted to see me play a level, confusion remained for students about what to do.

As for the latter, content on contracts was among the friction points identified by the sentiment analysis, which is consistent with the tendency that average exam scores for contracts have trended lower than the other two exams on the course materials.

DISCUSSION

There are some real wins from the work with genAI this semester to build a better aligned course that can better meet students where they are. Standard pathway students maintained high performance while exposed to more, higher-level work on the materials. Scaffolded students showed significant gains over their baseline, suggesting that additional lower-level work helped them to achieve measurable and significant learning gains. The work here is consistent with other studies on implementing learning pathways and achieve improved student performance.^{xiv xv} Gamified students appear to have beaten the historical average exam

scores, though additional data is probably necessary for this improvement to be statistically significant.

That said, there were problems with the course design given lower than expected exam scores on the contracts exam, and the higher than typical attrition rate. Sharma analyzes the mixed-results in the literature of the gamification of college-level courses, and attributes the mixed signals to relate with the implementation rather than the approach.^{xvi} Using analytical tools co-developed with genAI for sentiment and exam analysis, I was able to identify action items for incorporation into iterative changes to the course design for the next semester. Using generative AI tools to co-design those improvements helped me to implement those changes more quickly, while still permitting the opportunity for reflection and post-semester analysis of the results of the work in this area, implementing Schön's "reflection-in-action" approach to professional problem solving.^{xvii}

Based on the sentiment analysis findings, three targeted improvements were implemented for the upcoming semester.

First, I redesigned each module of learning activities in the LMS, using an application programming interface (API) call to genAI to prompt engineer a cleaner, HTML-based checklist interface that clearly shows required activities, completion status, and the rationale for pathway assignment. Each module landing page provides students with the overall course and more specific learning objectives, and then individualized checklists by learning path identify the specific tasks to complete and how each relates to each learning objective (see figures 1 - 4). Students will only see their checklist consistently throughout the semester using LMS conditions based on the student's initial response to whether they wish to gamify their course experience, and if not, based on the student's module pre-test score.

Second, I co-developed with genAI a new introductory quest and written instructions to introduce the students to the game by completing five core activities in the tutorial quest. This scaffolds the game experience itself, not just the legal content within it. To access the tutorial, students log in to Lawyer's Quest, select the Lawyer's Quest Tutorial, and then navigate the game using the instructions provided to complete activities on a checklist within the tutorial (interactions in BitTown, with riddle-protected treasure chests, and combat with enemies encountered outside of BitTown) (see figure 5).

Third, I utilized genAI to collect and analyze unit two exam items across sections over the last three years, and was able to pinpoint low performing items that I could target for revision and replacement (items that have poor discrimination – where low performing students on the overall exam are more likely to get the question right than high performing students – and also items with very low and very high p values where I improved the question stem itself or the potential answers so the item should be a better assessment of student knowledge of the materials).^{xviii}

I subsequently implemented design changes to the unit two exam to improve question reliability and discrimination. I removed two items from the exam with poor discrimination and low p, adjusted five additional items with high p, and added four fill-in-the-blank style questions from a larger pool of similar items, with this pool generated using API calls to genAI for importable items based on the assigned course reading.

In addition, I developed some additional instructional materials by identifying relevant contract cases, generating a script of short scenes using genAI API calls, and then utilizing

Sora (openAI's video generator) to create short videos illustrating each case and stitching those together into my pre-recorded lecture on the contracts materials.

This study demonstrates AI's potential role to amplify the faculty member's impact on the learning process. GenAI assisted at each stage of the action research cycle. As the instructor, I was able to marshal and direct resources to directly impact the course design and target sophisticated interventions using genAI throughout.

LIMITATIONS & CONCLUSION

Several limitations warrant consideration. Pathway assignment was not randomized; students were routed based on pre-test performance (Standard vs. Scaffolded) or self-selected (Gamified), introducing potential confounds. The positive gains for Scaffolded students may partially reflect regression to the mean, though the consistency across units argues against this as a complete explanation. Sample sizes for Scaffolded ($n = 40$) and Gamified ($n = 45$) pathways were modest, limiting statistical power for some comparisons. The study also did not consider other potential confounding co-variates, such as student GPA, race, gender, and other demographics. Finally, this study represents a single semester at one institution; replication across contexts is needed.

Student-centered learning requires that we adapt instruction to student readiness and preference—a principle the research literature has long advocated but practical constraints have long prevented. This study demonstrates that AI-assisted course design can make differentiated pathways practical at scale, and that such pathways are associated with meaningful learning outcomes improvements across student profiles. The study also illustrates how AI tools enable a complete action research cycle, from design through measurement, reflection, and iteration.^{xix} The sixteen students who withdrew are not merely a failure statistic; all student feedback—surfaced through AI-assisted sentiment analysis—drove targeted improvements that will benefit future sections of this course. This is the promise of AI in education: not automated instruction but augmented reflective practice supporting quality improvement.

GenAI tools today offer individual instructors the capacity to build responsive, individualized learning experiences that were previously the province of well-resourced research teams. Meeting students where they are has never been more achievable.

APPENDIX: SUMMARY STATISTICS

TABLE A1: STATISTICAL TESTS SUMMARY

Comparison	n	Effect	p	Sig.
Scaffolded vs Standard (gains)	216	$\beta = 23.69$	$< .001$	***
Gamified vs Historical	714	$d = 0.26$	.14	ns
Gamified vs Standard	216	$d = 0.29$	.09	ns
Gamified vs Scaffolded	85	$d = 0.29$	.19	ns

*Note: *** $p < .001$; ns = not significant. Gains analysis used mixed-effects regression; other comparisons used Welch's t-test.*

FIGURES

Module 1: Sources of Law ▾

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MNGT 140 Business Law I rev. 2026
Module 1 Sources of Law • Week 1

Course Objective
CO-561: CO-04 distinguish between sources of law as they apply to the business environment

Learning Objectives

LO-539: LO-01 identify the major sources of law that govern business activities in the United States.

LO-540: LO-02 compare the roles of constitutional law, statutory law, administrative regulations, and judicial decisions within the business environment.

Your Personalized Learning Path: Based on your selected learning path, you will see a customized checklist below with specific activities, readings, and assessments tailored to help you achieve these learning objectives.

Figure 1 Module Landing Page

Traditional Path 1
Strong foundation — focus on application

MNGT 140 Business Law I rev. 2026 • Module 1

Read OER pp. 1-34 — Read OER pp. 1-34
[Read OER](#)
LOs: LO-539, LO-540 • Knowledge level

Listen to the Lecture — Listen to the Pre-recorded Lecture on Sources of Law
[Listen to the Lecture](#) then test your knowledge with [Unit 1 Lecture 1 - Test Your Knowledge](#)
A skeletal outline is available to help you with taking notes [Unit 1 Lecture 1 Skeletal Outline.docx](#) along with a transcript if you prefer to read the content of the lecture [Unit 1 Lecture 1 Transcript.pdf](#).
LOs: LO-539, LO-540 • Comprehension level

Problem A — Apply your knowledge of the commerce clause with Problem A.
[Try Problem A](#)
LOs: LO-540 • Application level

Problem O — Work through the concept of pre-emption with Problem O
[Try Problem O](#)
LOs: LO-540 • Application level

Problem P — Apply your knowledge of the first amendment to Problem P
[Try Problem P](#)
LOs: LO-540 • Application level

Discussion Topic 2 — Analyze a situation involving the 1st amendment
[Topic 2](#)
LOs: LO-540 • Analysis level

Figure 3 Traditional Path 1 Checklist

Traditional Path 2
Building your foundation with additional practice

Read OER pp. 1-34
— Read OER pp. 1-34 [Read OER](#)
LO-539 LO-540 Knowledge level

Listen to the Lecture
— [Listen](#) to the Pre-recorded Lecture on Sources of Law then test your knowledge with: [Unit 1 Lecture 1 - Test Your Knowledge](#)
A skeletal outline is available to help you with taking notes [Unit 1 Lecture 1 Skeletal Outline.docx](#) along with a transcript if you prefer to read the content of the lecture [Unit 1 Lecture 1 Transcript.pdf](#).
LO-539 LO-540 Comprehension level

Problem A
— Apply your knowledge of the commerce clause with Problem A. [Try Problem A](#)
LO-540 Application level

Matching
— See if you can match the terms with their definitions from the reading [Matching for Module 1](#)
LO-539 LO-540 Knowledge level

Problem Set 1
— Test your knowledge from the reading with Problem Set 1 [Try Problem Set 1](#)
LO-539 LO-540 Comprehension level

Discussion Topic 2
— Analyze a situation involving the 1st amendment
LOs: LO-540 | Analysis level
[Topic 2](#)

Figure 2 Traditional Path 2 Checklist

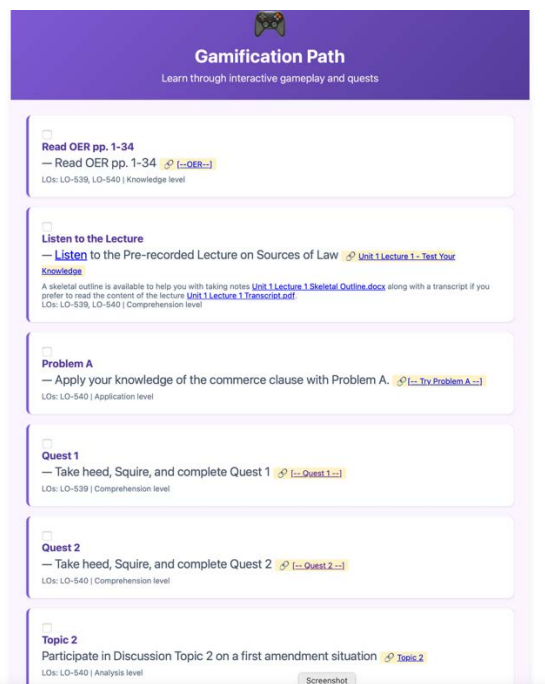


Figure 4 Gamified Path Checklist

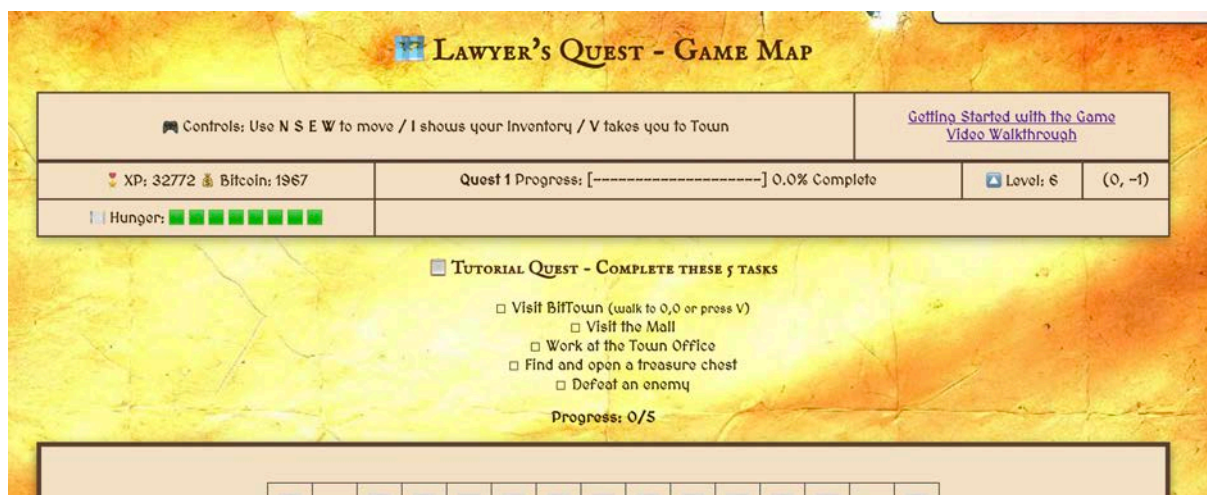


Figure 5 LQ Tutorial Checklist

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KEYWORDS: GENAI, GENERATIVE AI, AI, STUDENT-CENTERED LEARNING, PEAK TEACHING.