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Digital and AI-Enhanced Teaching Reform in the Introduction to the Digital Economy Course

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Abstract: Digital and AI tools are increasingly used in higher education, but evidence on their integrated use in digital economy courses remains limited. This study examined eight classes of Introduction to the Digital Economy at Xi'an University of Finance and Economics. Classes were categorized as traditional or digital and AI-enhanced according to whether the teaching reform had been implemented. Data were drawn from instructor questionnaires, semi-structured interviews, class-level grades, case-analysis scores, and learning-resource access records. Descriptive comparisons showed that mean lesson preparation time was 4.50 hours in the digital and AI-enhanced instruction group and 7.50 hours in the traditional instruction group, a 40% lower value. Teaching-method diversity averaged 3.50 and 1.50, respectively. The digital and AI-enhanced instruction group also recorded higher mean grades (81.5 vs. 76.9), case-analysis scores (80.1% vs. 66.7%), digital and AI resource visits (33.2 vs. 15.3), and views of emerging-topic materials (27 vs. 14). These descriptive findings associate digital and AI-enhanced instruction with lower preparation demands, more varied teaching methods, and better course outcomes. Because the study used a small, single-institution sample and descriptive comparisons, the findings should not be interpreted as causal.

1. Introduction

Generative artificial intelligence (AI), AI agents, and smart teaching platforms have drawn growing attention in higher education [1]. These technologies may support course design, reduce repetitive preparation tasks, broaden instructional methods, and improve learning outcomes [2]. However, evidence from specific disciplinary settings remains limited. This study examines their integrated use in an Introduction to the Digital Economy course at Xi'an University of Finance and Economics.

Digital and AI tools offer several capabilities relevant to teaching, including natural-language generation, information synthesis, task planning, and personalized content provision [3]. These capabilities are particularly relevant to Introduction to the Digital Economy, which combines theory, policy, and applied analysis. Course content covers digital technologies, data as a factor of production, platform economies, and industrial digitalization. Teachers must therefore update policy

materials, cases, activities, and learning resources regularly, which can create a substantial preparation workload [4]. Traditional lecture-based instruction may also struggle to accommodate differences in students' prior knowledge, comprehension, and learning pace [5]. Integrating generative AI, AI agents, smart teaching platforms, and online resources may support preparation, interaction, case analysis, project design, and learning beyond class [6].

Prior research has examined generative AI in content creation, personalized learning support, classroom interaction, and learning outcomes [7]. Studies also suggest that digital and AI tools can assist teachers with information retrieval, case design, slide preparation, and instructional planning [8]. Nevertheless, most research focuses on a single tool or instructional activity. Evidence on the combined use of generative AI, AI agents, smart teaching platforms, and online resources across an entire course remains scarce [9]. Few studies have examined instructor workload, teaching-method diversity, academic performance, case-analysis skills, and learning-resource use within one analytical framework.

Against this background, the study compares eight classes taught under traditional or digital and AI-enhanced instruction. It assesses lesson preparation time, teaching-method diversity, mean student grades, case-analysis scores, and learning-resource use. The analysis addresses whether integrated digital and AI use is associated with greater instructional efficiency and more favorable course-level outcomes.

The study contributes course-level evidence from digital economy education, a context that requires frequent content updates and close links between theory and practice. It also evaluates teacher workload and student outcomes together rather than treating them as separate dimensions. The findings provide a descriptive basis for refining digital and AI-enhanced teaching reform in comparable higher education settings.

2. Research Methods

2.1. Participants and Research Setting

This study was conducted within the university-level teaching reform project "Teaching Reform for Introduction to the Digital Economy in the Context of Digital and Intelligent Transformation" at Xi'an University of Finance and Economics. The study focused on the course and its instructors. Eight classes were randomly selected from those offering the course and were categorized by whether the teaching reform had been implemented. The traditional instruction group relied primarily on teacher-led lectures, with students mainly receiving information. The digital and AI-enhanced instruction group integrated generative AI tools such as DeepSeek, AI agents such as Codex, smart teaching platforms, and online resources. These tools were used in lesson preparation, classroom interaction, case analysis, project-based learning, and assessment. Baseline comparisons considered instructors' teaching experience and students' subject knowledge and prior academic performance. The instructors in the two groups had comparable teaching experience.

2.2. Data Collection and Measures

Data were collected through online questionnaires and semi-structured interviews with participating instructors. The questionnaire recorded lesson preparation time, instructional hours, AI use, and course-level teaching outcomes. Lesson preparation time was measured as the hours spent designing content, preparing slides, gathering cases, developing exercises, and organizing teaching resources. Instructional hours were measured as the number of class periods delivered. AI use was coded as 1 when an instructor used generative AI tools from OpenAI, DeepSeek, or another

provider for preparation or classroom teaching, and 0 otherwise. Teaching outcomes comprised mean student grades, case-analysis scores, and access to pre-class and post-class resources.

Before each face-to-face or telephone interview, the instructor provided consent for audio recording. Each interview lasted approximately 20 minutes and addressed five topics: changes in teaching effort, instructors' use of AI, implications for course reform, effects on instructors' psychological states, and willingness to support wider adoption.

The analysis used descriptive statistics to compare preparation time, teaching-method diversity, student performance, and learning-resource use across the two instructional groups. Given the small sample and non-random group classification, the results are interpreted as descriptive associations rather than causal effects.

3. Results

3.1. Lesson Preparation Time and Teaching-Method Diversity

Table 1 reports descriptive statistics for lesson preparation time and teaching-method diversity. Mean preparation time was 4.50 hours in the digital and AI-enhanced instruction group and 7.50 hours in the traditional instruction group. The difference was 3.00 hours, equivalent to 40%. The standard deviation was lower among digital and AI tool users (0.58 vs. 3.11), indicating less between-instructor variation in preparation time. Mean teaching-method diversity was 3.50 among users and 1.50 among non-users.

Relative to traditional instruction, teaching-method diversity was 133.33% higher in the digital and AI-enhanced instruction group. The pattern combined shorter average preparation time with greater reported diversity in teaching methods. These results are descriptive and do not establish that tool use caused the observed differences.

Table 1. Descriptive Statistics for Lesson Preparation Time and Teaching-Method Diversity by Instructional Group.

Type	N	Max	Min	Mean	SD
Lesson preparation time with digital and AI tools	4	5	4	4.50	0.58
Lesson preparation time without digital and AI tools	4	11	4	7.50	3.11
Diversity of teaching methods with digital and AI tools	4	4	3	3.50	0.58
Diversity of teaching methods without digital and AI tools	4	2	1	1.50	0.58

3.2. Teaching Outcomes

Table 2 compares course-level outcomes between the two instructional groups. The digital and AI-enhanced instruction group recorded higher values for all four indicators.

The mean student grade was 81.5 in the digital and AI-enhanced instruction group and 76.9 in the traditional instruction group. The difference was 4.6 points, or approximately 6.0% relative to the traditional instruction group.

Mean case-analysis performance reached 80.1% of the maximum score in the digital and AI-enhanced instruction group, compared with 66.7% in the traditional instruction group. This difference of 13.4 percentage points corresponds to approximately 20.1% relative to the traditional instruction group.

Learning-resource use also differed between groups. Students in the digital and AI-enhanced instruction group made 33.2 visits to digital and AI learning resources, compared with 15.3 visits in the traditional instruction group. This represents an increase of approximately 117.0%, or 2.17 times the traditional-group level. Views of guided materials on emerging digital economy topics were 27 and 14, respectively, a difference of approximately 92.9%.

Across the four indicators, digital and AI-enhanced instruction was associated with higher grades, stronger case-analysis performance, and greater resource use. These comparisons remain descriptive because the analysis did not use random assignment or inferential tests.

Table 2. Descriptive Statistics for Teaching Outcomes by Instructional Group.

Variable	Without Digital and AI Tools	With Digital and AI Tools
1. Average academic score	76.9	81.5
2. Case analysis score as a percentage of the maximum	66.7%	80.1%
3. Number of visits to digital and AI learning resources	15.3	33.2
4. Number of views of introductory materials on frontier topics in the digital economy	14	27

4. Discussion and Conclusions

This study examined how integrated digital and AI tools were associated with instructor workload, teaching-method diversity, and course outcomes across eight classes. Digital and AI tool users reported shorter preparation times and more varied teaching methods. Their classes also had higher mean grades, case-analysis scores, and learning-resource use. These patterns provide preliminary evidence in support of digital and AI-enhanced reform in Introduction to the Digital Economy.

The 3.00-hour difference in mean preparation time corresponded to a 40% lower value among tool users. Preparation time also varied less in this group, with standard deviations of 0.58 and 3.11. Teaching-method diversity averaged 3.50 among users and 1.50 among non-users, a difference of 133.33%. Together, these patterns suggest that digital and AI tools may reduce routine preparation demands while expanding the range of instructional approaches.

Three mechanisms may help explain this association. First, generative AI tools such as DeepSeek can support the production of theoretical explanations, cases, exercises, and discussion questions. Second, intelligent search and recommendation functions can help instructors locate and organize policy documents, industry cases, and recent research. Third, AI agents such as Codex can assist with project design, course organization, and assessment planning. These functions may streamline content development and resource management, but the present design cannot identify their causal contribution.

Course outcomes followed a similar pattern. Mean student grades were 81.5 in the digital and AI-enhanced instruction group and 76.9 in the traditional instruction group. Case-analysis scores were 80.1% and 66.7%, a difference of 13.4 percentage points. The findings are consistent with the possibility that AI-supported cases and project-based activities help students connect digital economy theory with practical problems. However, the study cannot isolate the effects of individual tools or teaching activities.

Students in the digital and AI-enhanced instruction group also used learning resources more frequently. Digital and AI resource visits averaged 33.2, compared with 15.3 in the traditional

instruction group. Views of guided materials on emerging topics averaged 27 and 14, respectively. Greater resource availability and easier access may have supported this engagement, although the available data do not establish the mechanism.

Overall, digital and AI-enhanced instruction was associated with lower preparation demands, greater teaching-method diversity, and more favorable course outcomes. The study is limited by its small, single-institution sample, descriptive analysis, and non-random classification of instructional groups. The findings should therefore be interpreted as preliminary rather than causal. Future research should use larger samples, stronger identification strategies, and longitudinal measures to assess effects on higher-order thinking, practical competence, and instructors' digital teaching capabilities.

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