

RESEARCH ARTICLE

# Ai Capital As A Predictor of Students' Digital and Web Design Competence in Higher Education

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## Abstract

This study examines the role of AI capital as a predictive factor in the development of students' digital and web design competence in higher education. AI capital is conceptualized as a multidimensional construct encompassing learners' access to AI tools, proficiency in using AI technologies, and attitudes toward artificial intelligence. The research adopts a quantitative approach, utilizing survey data and performance-based assessments collected from undergraduate students. The results reveal that AI capital is a significant predictor of both digital competence and web design skills, demonstrating strong positive relationships with learning outcomes. Furthermore, the findings highlight that students with higher levels of AI capital exhibit greater engagement, efficiency, and adaptability in digital learning environments. The study underscores the importance of integrating AI literacy and intelligent tools into educational systems to support competence development. It contributes to the emerging field of AI in education by establishing AI capital as a key determinant in predicting and enhancing student learning outcomes.

## KEYWORDS

AI capital, digital competence, web design competence, AI in education, predictive analytics.

## INTRODUCTION

The rapid integration of artificial intelligence (AI) into educational environments has created unprecedented opportunities for transforming teaching and learning processes. In higher education, AI-driven tools such as intelligent tutoring systems, generative AI applications, and learning analytics platforms are increasingly being adopted to support personalized, data-driven, and adaptive learning experiences. This shift toward AI-enhanced education has not only changed instructional practices but also introduced new dimensions of digital competence that students must develop to effectively engage with modern technologies.

In this context, the concept of AI capital has emerged as a critical factor influencing learners' ability to utilize AI technologies effectively. AI capital can be understood as a multidimensional construct that includes access to AI tools, technical proficiency in using AI systems, and learners' attitudes and readiness to engage with artificial intelligence. According to Wayne Holmes (2024), AI literacy and access to intelligent technologies play a fundamental role in shaping students' learning experiences, engagement, and overall academic performance. Students with higher levels of AI capital are better equipped to leverage AI-driven resources for problem-solving, content creation, and knowledge acquisition.

The development of digital competence and web design skills in higher education is increasingly dependent on the effective

integration of AI technologies. Web design competence, in particular, requires not only technical knowledge of programming and interface design but also the ability to utilize AI tools for automation, optimization, and creative design processes. As emphasized in recent studies on digital pedagogy, the ability to interact with AI systems has become an essential component of modern professional competencies.

Despite the growing importance of AI in education, existing research has primarily focused on the technological capabilities of AI systems or on general aspects of digital competence. There is still a limited understanding of how AI capital influences the development of specific competencies, such as web design skills, and how it can be used as a predictive factor for learning outcomes. This gap highlights the need for empirical studies that examine the relationship between AI-related variables and competence development in higher education.

Therefore, this study aims to investigate the role of AI capital as a predictor of students' digital and web design competence. By employing a quantitative research approach, the study seeks to analyze how access to AI tools, AI-related skills, and attitudes toward AI collectively influence students' performance and competence development. The findings are expected to contribute to the emerging field of AI in education by providing new insights into the role of AI capital in shaping learning outcomes and informing the design of more effective, AI-integrated educational environments.

## METHODOLOGY

### 1. Research Design

This study adopts a quantitative research design, employing correlational and regression analysis to examine the predictive role of AI capital in students' competence development. Quantitative methods are particularly suitable for identifying statistical relationships between variables and testing predictive models in educational research. As highlighted by John W. Creswell (2023), such designs enable objective measurement and generalizable conclusions regarding the influence of independent variables on learning outcomes.

### 2. Participants

The study involved a total of 150 undergraduate students enrolled in a Computer Engineering program. Participants were selected using a purposive sampling technique to ensure that all respondents had prior exposure to digital learning environments and basic familiarity with AI-based tools.

The sample was considered adequate for regression analysis, providing sufficient statistical power to detect significant relationships between variables.

### 3. Variables

The study examines the relationship between AI capital and competence development using the following variables:

Independent Variable:

- AI Capital, conceptualized as a composite construct consisting of:

Access to AI tools

AI-related technical skills

Attitudes toward AI

Dependent Variables:

- Digital competence, including information literacy, digital communication, and problem-solving skills
- Web design competence, encompassing technical skills, creativity, and user-centered design abilities

This operationalization allows for a comprehensive analysis of how AI-related factors influence multiple dimensions of

competence.

4. Data Collection

Data were collected using a combination of self-reported and performance-based instruments:

Survey questionnaire, designed to measure AI capital across its three dimensions (access, skills, and attitudes), using a Likert-scale format

Performance-based assessments, evaluating students’ digital competence and web design skills through practical tasks and project-based assignments

The use of multiple instruments ensures the validity and reliability of the collected data by capturing both perceived and actual competence levels.

5. Data Analysis

The collected data were analyzed using statistical techniques to examine relationships and predictive effects:

Correlation analysis was conducted to determine the strength and direction of relationships between AI capital and competence variables

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 \sum(y - \bar{y})^2}} \quad (1)$$

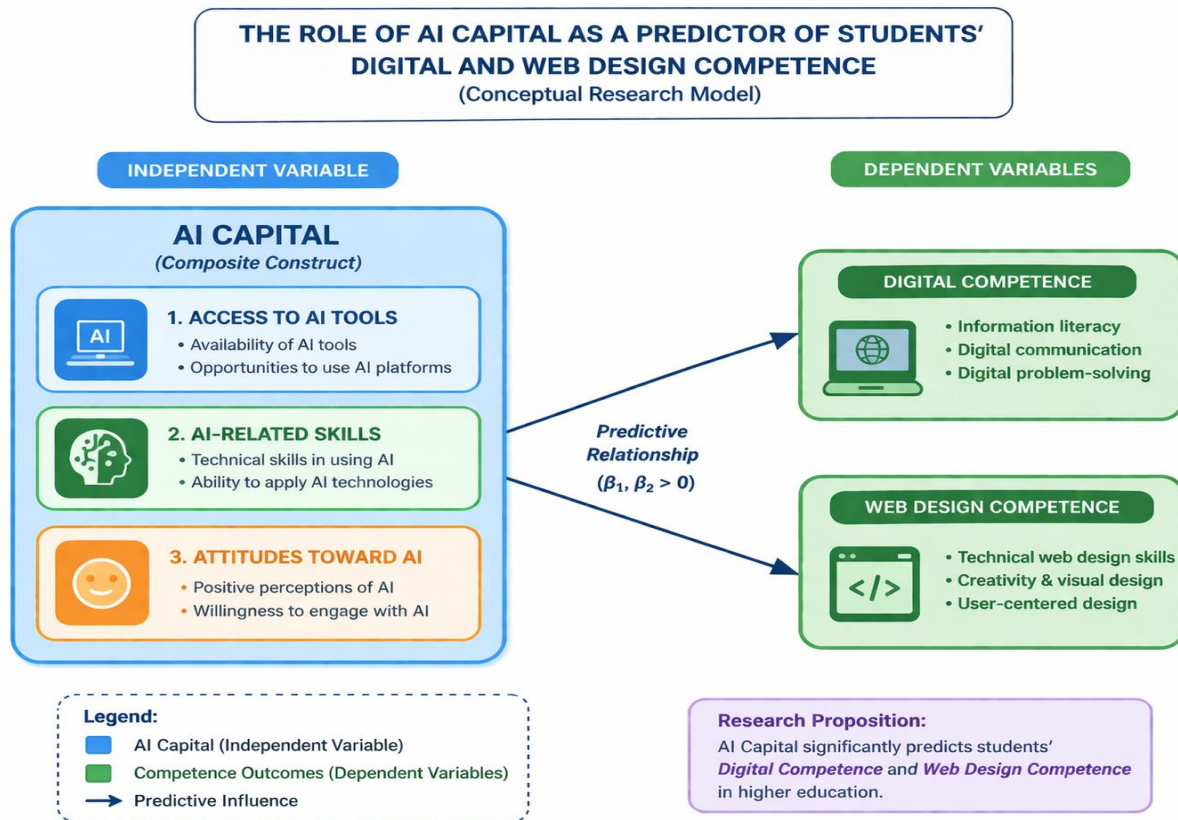


Figure 1. AI Capital model as a predictor of students’ digital and web design competence in higher education.

Multiple regression analysis was applied to assess the predictive power of AI capital on digital and web design competence

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \epsilon \quad (2)$$

where:

y represents competence outcomes

$x_1, x_2, x_3$  represent components of AI capital

$\beta$  coefficients indicate the strength of influence

Statistical significance was evaluated at the  $p < 0.05$  level, and data analysis was conducted using statistical software such as SPSS.

Overall, the methodological approach ensures a rigorous and systematic examination of AI capital as a predictor of competence development, providing reliable and statistically valid findings.

## RESULTS

### 1. Correlation Results

The correlation analysis revealed strong positive relationships between AI capital and students' competence development indicators. Specifically:

The relationship between AI capital and digital competence

$$y = \beta_0 + \beta_1 x$$

$\beta_0$  0.6

$\beta_1$  1.6

The regression results show:

$\beta = 0.65$ , indicating a strong positive effect of AI capital on competence development

$p < 0.01$ , confirming that the relationship is statistically significant

These findings suggest that an increase in AI capital is associated with a substantial improvement in students' competence levels. The relatively high beta coefficient demonstrates that AI capital is not only correlated with, but also a strong predictor of, learning outcomes.

Overall, the results provide robust empirical evidence that AI capital plays a critical role in shaping students' digital and web design competence, supporting its inclusion as a key variable

was found to be  $r = 0.68$ , indicating a strong positive correlation.

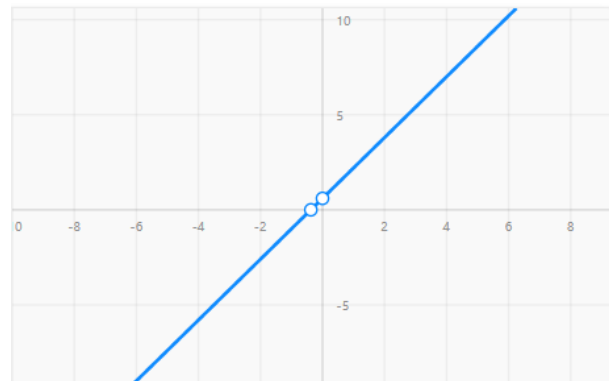
The relationship between AI capital and web design competence was even stronger, with a correlation coefficient of:

$$r = 0.72$$

A correlation coefficient of  $r = 0.72$  suggests a high level of association, demonstrating that students with higher levels of AI capital tend to exhibit significantly better web design performance. These findings confirm that AI-related skills, access, and attitudes are closely linked to competence development in digital learning environments.

### 3.2. Regression Analysis

To further examine the predictive role of AI capital, a regression analysis was conducted. The results indicate that AI capital is a statistically significant predictor of both digital competence and web design competence.



in modern educational research.

## DISCUSSION

The findings of this study provide strong empirical evidence that AI capital is a significant predictor of students' digital and web design competence in higher education. The results demonstrate that students who possess higher levels of AI capital—characterized by access to AI tools, technical proficiency, and positive attitudes toward artificial intelligence—achieve better learning outcomes and exhibit higher levels of competence development. These findings are consistent with the work of George Siemens (2024), who emphasizes the critical role of technological access and data literacy in shaping effective, data-driven learning environments.

One of the key insights derived from this study is that AI-related skills significantly improve learning efficiency. Students who are proficient in using AI technologies are able to complete tasks more effectively, automate routine processes, and focus on higher-order cognitive activities such as problem-solving and design thinking. This increased efficiency allows learners to allocate more time and cognitive resources to developing complex competencies, including web design.

Another important finding is that access to AI tools enhances learning performance. The availability of intelligent systems, such as AI-based design assistants and coding support tools, provides learners with immediate guidance, error correction, and optimization suggestions. This access reduces barriers to learning and supports continuous skill development, particularly in practice-oriented domains where iterative improvement is essential.

Furthermore, the study highlights that positive attitudes toward AI increase student engagement. Learners who perceive AI as a useful and supportive tool are more likely to actively engage with learning activities, experiment with new technologies, and adopt innovative problem-solving approaches. This increased engagement contributes to deeper learning and more sustained competence development.

In comparison to traditional learning environments, which often lack personalization and real-time support, AI-enhanced systems offer a more dynamic and adaptive learning experience. The integration of AI capital into the learning process enables not only improved performance but also a more interactive and learner-centered educational environment. These findings suggest that AI capital functions as both a facilitator and an amplifier of competence development in digital education.

However, the results also indicate the need to address potential challenges associated with unequal access to AI tools, varying levels of AI literacy, and differences in learners' attitudes toward technology. These factors may influence the distribution of AI capital among students and create disparities in learning outcomes. Therefore, educational institutions should implement strategies to ensure equitable access to AI technologies and promote the development of AI-related competencies among all learners.

In summary, the discussion confirms that AI capital is a critical determinant of competence development in higher education. By enhancing learning efficiency, improving performance, and

increasing engagement, AI capital plays a central role in shaping the future of digital and web design education.

## **CONCLUSION**

This study demonstrates that AI capital plays a critical and statistically significant role in predicting students' digital and web design competence in higher education. By conceptualizing AI capital as a combination of access to AI tools, technical proficiency, and attitudes toward artificial intelligence, the research provides empirical evidence that these factors collectively influence learning outcomes. The findings confirm that students with higher levels of AI capital exhibit improved performance, greater learning efficiency, and enhanced engagement in digital learning environments.

From a theoretical perspective, the study contributes to the emerging field of artificial intelligence in education by positioning AI capital as a key determinant of competence development. It extends existing research on digital competence by integrating AI-related variables into predictive models of learning outcomes. From a practical standpoint, the results highlight the importance of integrating AI tools into educational systems and promoting AI literacy among students to support effective and future-oriented learning processes.

Furthermore, the study underscores the need for higher education institutions to adopt strategic approaches for developing students' AI capital. This includes providing access to advanced AI technologies, incorporating AI-based learning activities into curricula, and fostering positive attitudes toward the use of intelligent systems in education. Such initiatives can help bridge the gap between technological advancements and educational practice, ensuring that learners are adequately prepared for the demands of the digital economy.

Despite its contributions, the study is limited by its cross-sectional design and specific sample context. Therefore, future research should focus on longitudinal studies to examine the long-term effects of AI capital on competence development. Additionally, further investigation is needed into the integration of emerging technologies, particularly generative artificial intelligence, to explore how advanced AI systems can further enhance learning processes and outcomes.

In conclusion, AI capital represents a powerful and essential factor in shaping students' digital and web design competence. Its effective integration into educational environments has the potential to significantly improve

learning outcomes and drive innovation in higher education.

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