

# Digital Technology, Digital Literacy and the Quality of Postgraduate Education

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**Abstract.** How do graduate students perceive the quality of digital education? With considering the characters of postgraduates, this research examined the mediating role of academic self-efficacy and the moderating effect of digital literacy in the basic model. A survey of 1,256 graduate students in the southwestern region of China was conducted, and structural equation modeling and curve fitting were adopted for mechanism analysis. The research found that the level of digitization in higher education institutions affects postgraduate students' perception of academic self-efficacy, which in turn influences their perceived education quality. Furthermore, in digital education within higher education institutions, postgraduate students with high digital literacy perceive higher perceived education quality compared to those with low digital literacy. The relationship between digital technology and postgraduate students' perceived education quality is not linearly increasing, but rather follows a steep and then smooth upward curve.

**Keywords:** Digital technology; postgraduate education; Educational quality; Information literacy

Current researches regarding the impact of digital technology on the quality of graduate education is limited to the theoretical level, lacking in-depth research on the influencing process and mechanisms, especially on how digital technology affects academic self-efficacy and subsequently influences the perception of graduate education quality[1]. This study aims to construct a model and provide empirical evidence to reveal the relationship between digital technology and the perceived education quality of postgraduate education.

## 1. Research Hypotheses and Models

### 1.1 Digital Technology and Academic Self-Efficacy

Researches in academia on the level of digital development in universities mainly measure digitization from the perspectives of value, institution, resources, and organization[2,3]. This paper divides the digital development of universities into two dimensions: digital technology hardware environment and digital technology software environment[4]. The digital technology hardware environment in universities refers to facilities and platforms that provide digital technology support and resources for students, faculty, staff, and researchers, including computer labs, digital libraries, academic software and tools, online learning platforms, etc. The digital technology software environment in universities covers the knowledge and skills related to digital technology taught to students during the educational and training process, as well as digital teaching resources, such as online courses, online exercises, online communities, research-oriented databases, etc.

According to the theory of empowerment, digital technology empowerment helps to improve the self-efficacy of the empowered individuals[5]. Self-efficacy refers to the individual's speculation and judgment on whether they have the ability to complete a certain behavior. Academic self-efficacy refers to the confidence and belief of individuals in their ability to complete tasks, achieve goals, and succeed in the academic field[6,7]. Currently, with the rapid increase of learning intelligent tools such as Artificial Intelligence Generated Content (AIGC), which represent the application of digital technology, information mining, data utilization, and autonomous creation, postgraduate students' personalized academic training needs are met in a low-energy and efficient manner. It can guide postgraduate students to build their learning paths at a reasonable pace through



## 2. Data Collection

The measurements of the digital technology hardware environment and digital technology software environment and literacy were adapted from the scales used by Yang et al.[13]. The measurements of academic self-efficacy and perceived education quality were adapted from the scale developed by Kahraman et al.[14]. All indicators were measured using a 7-point Likert scale in the questionnaire.

The online questionnaire was designed using the Wenjuanxing platform and distributed to postgraduate students in universities in the southwest region of China. A total of 1,256 questionnaires were collected. After excluding questionnaires that failed attention checks or were duplicates, 1230 valid questionnaires were obtained, resulting in a valid response rate of 97.93%.

## 3. Data analysis

With SPSS 26.0 and AMOS 28.0 software, data analysis was conducted to examine the reliability and validity of the scale, test model assumptions, and assess model fit.

### 3.1 Common Method Bias Test

This study employed the Harman's single-factor test to examine common method bias. As shown in Table 2, the KMO value was 0.974, which is greater than 0.6, meeting the prerequisite for factor analysis.

Table1. KMO and Bartlett's test

|                               |                              |           |
|-------------------------------|------------------------------|-----------|
| Kaiser-Meyer-Olkin measure    |                              | 0.974     |
| Bartlett's test of sphericity | Approximate chi-square value | 22591.838 |
|                               | df                           | 406       |
|                               | P-value                      | 0.000     |

### 3.2 Validity and Reliability Testing

The obtained alpha coefficients all exceeding the recommended value of 0.70. This indicates good internal consistency. In addition, the composite reliability (CR) values ranged from 0.867 to 0.928, and the factor loadings were all above 0.70. The average variance extracted (AVE) for each factor exceeded 0.50, demonstrating good convergent validity.

### 3.3 Model Fit Analysis

Hypothesis testing was conducted by using AMOS 28.0 software, and the results of the model fit are shown in Table2, indicating that the model is simulated well.

Table 2. Model fit indicators

| Indicator | model indicator values | Standard                       | Conclusion |
|-----------|------------------------|--------------------------------|------------|
| CMID/DF   | 3.134                  | <3 excellent, <5 acceptable    | Acceptable |
| GFI       | 0.953                  | >0.8 acceptable, >0.9 good fit | Good fit   |
| AGFI      | 0.943                  | >0.8 good fit, >0.9 good fit   | Acceptable |

|           |       |                                |          |
|-----------|-------|--------------------------------|----------|
| CFI       | 0.974 | >0.9                           | Good fit |
| TLI(NNFI) | 0.971 | >0.9                           | Good fit |
| RMSEA     | 0.042 | 0.08excellent, <0.1 acceptable | Good fit |
| SRMR      | 0.053 | <0.08                          | Good fit |

### 3.4 Hypothesis Testing

The standardized coefficients and significance results of the main paths in the structural equation model can be found in Table 3. The absolute values of the C.R. for the main paths are all greater than 1.96, and the p-values are all less than 0.05. Therefore, all three hypotheses for the main paths are supported.

Table 3. The results of the model path analysis

| Hypothesis   | Unstd. | S.E.  | C.R.   | P   | Std. ( $\beta$ ) |
|--|--------|-------|--------|-----|------------------|
| digital technological software environment→academic self-efficacy  | 0.286  | 0.023 | 12.413 | *** | 0.391            |
| digital technological hardware environment →academic self-efficacy | 0.409  | 0.029 | 14.009 | *** | 0.476            |
| academic self-efficacy →perceived educational quality              | 0.861  | 0.038 | 22.953 | *** | 0.849            |

### 3.5 Moderation Effect Test

The results of the moderation effect path test are shown in Table 4, and the P values for both Interaction A and Interaction B are less than 0.05, indicating that hypotheses H4 and H5 are supported.

Table 4. Moderation effect path test results

| Path                                       |   |                        | Unstd. | S.E.  | C.R.   | P   | Std. ( $\beta$ ) |
|--|---|------------------------|--------|-------|--------|-----|------------------|
| Digital technological hardware environment | → | Academic self-efficacy | 0.253  | 0.028 | 9.170  | *** | 0.302            |
| digital literacy                           | → | Academic self-efficacy | 0.464  | 0.041 | 11.293 | *** | 0.472            |
| Interaction term A                         | → | Academic self-efficacy | 0.064  | 0.015 | 4.363  | *** | 0.136            |
| Digital technological software environment | → | Academic self-efficacy | 0.317  | 0.031 | 10.386 | *** | 0.348            |
| digital literacy                           | → | Academic self-efficacy | 0.420  | 0.039 | 10.786 | *** | 0.427            |
| Interaction term B                         | → | Academic self-efficacy | 0.094  | 0.018 | 5.228  | *** | 0.165            |

### 3.6 Mediation Effect Test

The mediation effect of academic self-efficacy was tested by adopting Preacher's method of Bootstrap resampling with 2000 iterations, which provides more stable and accurate measurement results, as shown in Table 5.

Table 5. Path coefficients of the mediation effect model.

| Mediation paths   | Indirect effect coefficient | Two-tailed test p-value | 95% confidence interval |             | Mediation effect |
|---|-----------------------------|-------------------------|-------------------------|-------------|------------------|
|   |                             |                         | Lower bound             | Upper bound |                  |
| Digital technological hardware environment-Academic self-efficacy-Perceived perception of educational quality | 0.278                       | 0.001                   | 0.210                   | 0.345       | Support          |
| Digital technological software environment-Academic self-efficacy-Perceived perception of educational quality | 0.370                       | 0.001                   | 0.305                   | 0.449       | Support          |

### 3.7 Curve fitting

It has been previously proven that both the digital technology hardware environment and the digital technology software environment have an impact on perception of educational quality. However, is this impact linearly increasing? If it is, then what need to improve is the overall digital technology level and digital literacy of the whole society. But in reality, this is not the case. To further understand the impact of digital technology on perception of educational quality, this study conducted curve fitting analysis, as shown in Figure 2. The results indicate a good fit for the model with an R-squared value of 0.766. Overall, as the level of digital technology improves, postgraduate students' perception of educational quality also increases. However, there is a diminishing rate of improvement in perception of educational quality as the digital technology level of universities reaches a certain threshold. This suggests that relying solely on digital technology to enhance perception of educational quality has a higher marginal effect only within a specific time frame.

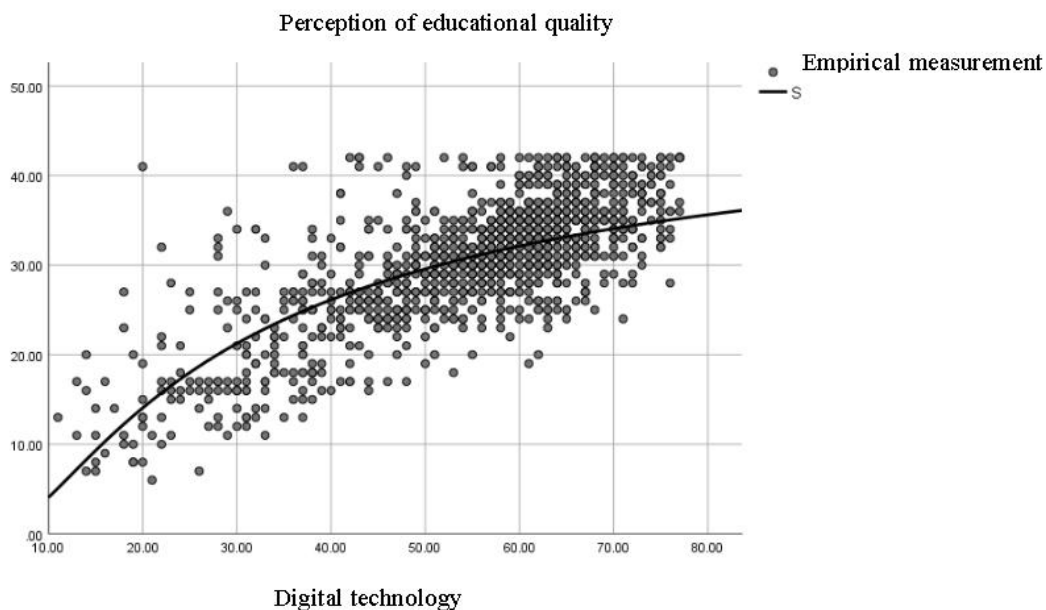


Figure2 Curve fitting analysis

## 4. Conclusion

The research results of this paper show that digital technology can improve postgraduate students' academic self-efficacy, thereby enhancing their perception of educational quality, and this perception increases with the improvement of postgraduate students' personal digital literacy.

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