

Construction of Micro-Project-Based Teaching Model for Ideological and Political Courses in Higher Vocational Colleges under the Digital Era: A Study on Teaching Effectiveness Evaluation Based on Student Participation

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ABSTRACT Vocational school students generally value practice more than abstract theory, and their cognitive characteristics make traditional teaching models difficult to adapt to contemporary classroom needs. This study constructs a digital micro-project-based teaching model for ideological and political theory courses and examines its effect on teaching effectiveness with student participation as the mediating variable. To strengthen its relevance for engineering-oriented talent cultivation, the model organizes learning tasks through data-supported platforms and scenario-based micro-projects that can be connected with technical, communication, and manufacturing contexts. A total of 270 students from three classes in a higher vocational college were selected as research subjects, and experimental comparison was combined with questionnaire surveys. After eight weeks of teaching practice, student participation was measured from behavioral, affective, and cognitive dimensions, and teaching effectiveness was evaluated accordingly. A micro-project task library, a digital support platform, and a full-process evaluation system were designed, while classroom observation data, platform behavior logs, and satisfaction survey data were collected and analyzed. Mediation analysis indicates that student participation fully mediates the relationship between micro-project teaching and teaching effectiveness. The results show that the digital micro-project model can stimulate classroom participation and improve the effectiveness of ideological and political education through deeper learner engagement.

INDEX TERMS micro-project learning, student participation, digital learning platform, engineering education, teaching effectiveness

I. INTRODUCTION

DIGITAL technology has not only transformed the dissemination of knowledge but has also reshaped student learning habits through the virtual simulation of the digital modeling of high-performance fiber properties. This shift significantly impacts cognitive patterns by allowing students to interact with the interwoven logic of technical engineering in a multidimensional, data-driven environment. However, the current ideological and political theory classes in higher vocational colleges still encounter many difficulties: on the one hand, traditional lecture courses in the classroom are dominated by the teacher, and the student is in a passive state of receiving information and with a low level of participation; on the other hand, a higher vocational student generally has the cognitive characteristics of “strong hands-

on ability but weak theoretical interest,” and is prone to becoming alienated by purely theoretical lectures. Student engagement is a key mediating variable in the measurement of the effectiveness of teaching models. According to the three-dimensional framework of the engagement theory, student engagement can be categorized in three levels: behavioral engagement, affective engagement, and cognitive engagement. Behavioral engagement is the level of participation related to classroom activities; affective engagement is the level of student interest in, belonging to, and value identification with, the content being learned; and, cognitive engagement refers to the cognitive strategies and depth of thinking that students use in the course of learning.

II. RELATED WORK

The academic community has launched multi-dimensional explorations into the integration of ideological and political education with high-performance technical engineering and intelligent technologies, fostering innovation through interdisciplinary synergy. This approach utilizes the structural logic of advanced fiber systems as a vehicle for exploring professional ethics and industrial craftsmanship within the framework of modern higher education. Wang et al. [1] analyzed the role of music teaching in colleges and universities in promoting ideological and political work and the necessity of integration. Qi et al. [2] proposed and designed an online and offline teaching connection system for ideological and political education in colleges and universities based on deep learning. Guan [3] proposed a practical path for the collaborative education of physical education and ideological and political education. Deng et al. [4] introduced knowledge graph technology to improve the teaching methods of ideological and political education, aiming to solve the pain points of fragmented knowledge, difficulty for students to build a systematic cognitive system and weak teaching interaction in traditional teaching. From the perspective of teaching management, Wang [5] explored the key role and challenges of teaching management innovation in promoting and exploring the reform of ideological and political education in the field of higher education. Liu [6] proposed a balanced scheduling method of ideological and political teaching resources based on cluster analysis algorithm. Zhang and Wang [7] pointed out that through teaching methods such as project-based learning, cooperative learning, reflective writing and real experience, students' in-depth participation and emotional investment in ideological and political English courses can be significantly improved. Li and Li [8] believe that improving teaching quality is a systematic project and requires multiple measures. Wang [9] constructed an ideological and political cognitive teaching model suitable for higher vocational English courses. Zhu et al. [10] introduced the concept of outcome-oriented education and realized the transformation from "what was taught" to "what students learned". The above studies have provided multiple theoretical perspectives and technical references for the reform of ideological and political education in higher vocational colleges, but insufficient attention has been paid to the key intermediary variable of student participation in the learning process and its deep correlation mechanism with teaching effectiveness. This article constructs a new form of ideological and political classrooms oriented by deep student participation, and empirically tests its impact mechanism on teaching effectiveness, in order to provide theoretical and practical reference for improving the affinity and effectiveness of ideological and political courses in higher vocational colleges.

III. METHODS

A. DESIGN OF DIGITAL MICRO-PROJECT-BASED TEACHING MODEL

The digital micro-project teaching model that has been built in this research study contains three main modules, including micro-project task library, digital support platform and whole-process evaluation system [11]. The design of the task library for micro-projects is in line with the principle of "small entrance, emphasis on experience and transferability", that is, the core knowledge points in the ideological and political courses are turned into micro-inquiry inquiry tasks as close to the professional background and life experience of higher vocational students as possible. For example, the project "Honesty Ethics in Live Streaming" organized for e-commerce students requires the participation of students in the analysis of ethical issues in genuine cases of live streaming and the development of improvement proposals. The project, "Smart Manufacturing

Powerhouse: Green Technology and Sustainable Development Responsibility," aimed at students majoring in intelligent control and manufacturing, requires students to investigate and analyze energy consumption and pollution issues in intelligent production processes, and, in conjunction with the concept that "lucid waters and lush mountains are invaluable assets," design an "Implementation Plan for Energy Conservation and Environmental Responsibility in Intelligent Manufacturing Workshops." The cycle of each micro-project is kept in control within 2-3 weeks, which implies sufficient time for exploration of students and to avoid learning fatigue due to excess cycling.

The digital support platform is constructed based on "self-built + integrated" model which incorporates 5 major functions, including task release, resource push, process record, collaborative communication and results submission. The platform is integrated with the existing learning system of the school to accomplish automatic synchronization of student data. In terms of resource push, the platform automatically suggests relevant literature, videos, case studies and

VR venue resource based on the project theme. For example, to complete the "craftsman spirit" themed project, students can click to watch a video interview with the master craftsmen and enter the production line of enterprises through VR. The process recording function will automatically collect on the platform the learning behavior data of students' learning behaviors such as browsing time of web resources, number of posts in the discussion area, contribution to the collaborative tasks, etc., to provide data support for the subsequent evaluation of the participation [12].

The comprehensive evaluation system is a combination of formative and outcome-based evaluations. Formative assessment is worth 60% overall and consists of automatically recorded information on behaviour (30%), peer assessment scores (15%) and records of teacher observations (15%). Outcome based assessment - 40% of entire grade - Outcome-based assessment is based on the final quality

of the project deliverables by teachers using standardized criteria of score. After each project the platform automatically produces a participation report and outcome evaluation report for each student that are then stored in their individual student profile.

B. RESEARCH SUBJECTS AND EXPERIMENTAL DESIGN

This study selected 270 students from three first-year classes in three vocational schools in a certain region as research subjects, including 178 boys and 134 girls, with an average age of 18.6 years. These three classes included science and engineering majors as well as humanities majors,

and there were no significant differences in their entrance examination scores, gender ratio, and level of ideological and political education before enrollment. This study was approved by the Ethics Committee of Weihai Ocean Vocational College, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

The experiment lasted for two semesters, and the teaching content selected two modules from the course “Ideological and Moral Education and the Rule of Law”: “Ideological and Moral Education and the Rule of Law” and “Practice of Socialist Core Values”. The experimental group adopted a digital micro-project teaching model, in which students worked in groups of 4-5 people to complete two micro-project tasks within eight weeks. The control group adopted a traditional lecture-based teaching model. However, to ensure fairness and avoid impacting student motivation due to differences in technology access (digital divide), students in the control group were also authorized to use the digital learning platform. However, the control group’s use of the platform was strictly limited to accessing course materials and submitting assignments online; core functions such as task management, process recording, collaborative communication, and results presentation were not enabled. This means that while the control group shared the digital technology environment with the experimental group, it did not apply the core elements of the micro-project teaching model. The teaching content and progress were consistent with the experimental group, but no micro-project activities were carried out, and the task management and process recording functions of the digital support platform were not used [13], [14]. To ensure the internal validity of the experiment, both groups of students maintained consistency in terms of teaching time, textbook use, and homework load. Prior to the experiment, both groups underwent preliminary testing, including a test of basic ideological and political knowledge and a baseline participation survey. The results showed no significant differences between the two groups, indicating that they were comparable.

C. DATA ACQUISITION TOOLS AND PROGRAMS

This study employed a multi-source data collection method, combining questionnaire surveys, classroom observations,

and platform log analysis.

The student participation questionnaire was revised based on existing mature scales and combined with the teaching context of ideological and political courses in higher vocational colleges. The questionnaire includes three dimensions: behavioral participation, affective participation, and cognitive participation, with a total of 18 items. The behavioral participation

dimension measures students’ level of engagement in classroom discussions, group collaboration, and task completion; the affective participation dimension measures students’ interest in ideological and political courses, their sense of identification with the learning content, and their experience of cooperating with peers; the cognitive participation dimension measures the deep learning strategies used by students in the learning process, such as critical thinking, knowledge integration, and reflection ability [15].

The teaching effectiveness assessment tool was a self-designed questionnaire, comprising three dimensions: knowledge mastery, ideological and political identification, and ability transferability, with a total of 15 items. Knowledge mastery measures students’ recall and understanding of core concepts in ideological and political courses; ideological and political identification measures students’ identification with socialist core values and their awareness of their significance for personal growth; and ability transferability measures students’ awareness and ability to apply ideological and political literacy to professional practice and daily life. The questionnaire also used a five-point scoring system, with an overall Cronbach’s α coefficient of 0.91.

The platform behavior log data collection included all operation records of students in the experimental group on the digital support platform, including login times, resource browsing time, number of posts and replies in the discussion forum, and contribution to group collaborative tasks. Classroom observation was conducted by two trained research assistants who entered the classrooms of the experimental and control groups respectively, recording students’ classroom participation status every 5 minutes, including attention level, number of times they actively spoke, and interaction with peers.

IV. RESULTS AND DISCUSSION

A. ANALYSIS OF INTER-GROUP DIFFERENCES IN STUDENT PARTICIPATION

Test the impact of the digital micro-project teaching model on student participation. The results are shown in Table 1.

TABLE 1. Comparison of post-test scores of student participation between the experimental and control groups

Participation Dimension	Experimental group (n=135)	Control group (n=135)	t-value	p-value	Cohen's d
Behavioral Participation	4.28 ± 0.43	3.51 ± 0.58	13.24	< 0.001	1.50
Emotional participation	4.15 ± 0.51	3.38 ± 0.62	11.98	< 0.001	1.36
Cognitive Participation	3.98 ± 0.56	3.22 ± 0.67	10.85	< 0.001	1.23

Table 1 shows that the score of students in the experimental group was significantly more than the control group on

all three dimensions of behavioral, affective and cognitive participation ($p < 0.001$), with an effect size of Cohen's d of 1.23-1.50. This showed that the digital micro-project-based teaching model has a large practical impact on the enhancement of student participation. Of these, behavioral participation results showed the most improvement with a mean score of 4.28 for the experimental group that was found to be significantly higher than the control group with a mean score of 3.51. This result can be explained from two aspects:

- Micro-project based teaching itself has "task driven" characteristic, which requires students to put more time and extra work into a certain project task.
- The recording function of digital platform provides stronger "task awareness" to students, enabling them to see their task progress and the contribution of their peers, thereby stimulating their motivation to participate.

The fact that improved emotional engagement has been significantly increased is notable. The mean emotional engagement score of the experimental group was found to be 4.15, which was significantly higher than that of the control group which was 3.38. Classroom observation records showed that the learning interest of students in the experimental group was higher, and the level of peer interaction during group collaboration was higher. One student interviewed put it this way, "Before, political education classes were just about listening to the teacher lecture." Now we get to do research and talk and present on our own, so it just feels like political education is related to my major and my life." This sense of connection can be described as a key element of emotional engagement and indicates that micro-project based teaching, by creating authentic scenarios, enables students to make a meaningful connection between political education and their personal experiences.

Although the increase in cognitive engagement was slightly lower than that in the first two dimensions, it was still significant. The results showed that the average cognitive engagement score in the experimental group was 3.98, while that in the control group was 3.22. This phenomenon warrants further investigation: while the micro-project teaching model significantly stimulated students at the behavioral and affective levels, its promotion of higher-order thinking (such as critical analysis, knowledge transfer, and metacognitive reflection) did not seem to reach the same level. Therefore, this study critically reflects on this from the perspective of digital model application. First, the current digital platform mainly focuses on resource delivery, process recording, and result submission, offering limited scaffolding for guiding students to conduct in-depth exploration. For example, the platform failed to effectively simulate the complex "structure-performance" logical relationship in high-performance fiber-reinforced material testing. This process of concretizing abstract thinking still requires extensive offline guidance from teachers, limiting students' space for

independent higher-order thinking. Second, the short design cycle and focused tasks of micro-projects, while enhancing the "sense of task," may unintentionally lead students to concentrate on completing specific tasks, weakening in-depth reflection and knowledge integration across projects and contexts. Therefore, students' application of cognitive engagement strategies remains at a superficial level and has not yet been fully internalized as a thinking habit for solving complex problems. This suggests that future optimization of teaching models should focus more on the ability of digital platforms to support higher-order cognitive activities, rather than just task management and resource presentation.

B. TESTING OF INTER-GROUP DIFFERENCES AND MEDIATING EFFECTS IN TEACHING EFFECTIVENESS

Based on the examination of differences in participation, the differences in teaching effectiveness between the two groups of students were further analyzed, and the mediating effect of participation was examined. The teaching effectiveness assessment included three dimensions: knowledge mastery, ideological and political identification, and ability transferability. The results are shown in Table 2.

TABLE 2. Comparison of post-test scores of teaching effectiveness between the experimental group and the control group

Teaching effectiveness dimension	Experimental group (n=135)	Control group (n=135)	t-value	p-value	Cohen's d
Knowledge mastery	4.32 ± 0.48	3.81 ± 0.63	8.02	< 0.001	0.91
Ideological and political identity	4.41 ± 0.45	3.69 ± 0.71	10.56	< 0.001	1.20
Ability transferability	4.08 ± 0.59	3.38 ± 0.74	9.17	< 0.001	1.04

Table 2 indicates that the experimental group had significant scores compared to the control group in all dimensions of teaching effectiveness ($p < 0.001$). The most significant difference was with the ideological and political identification, the experimental group obtained 4.41 points for the control group 3.69 points (effect size $d = 1.20$). This finding confirms conclusions of already existing research: project-based learning can significantly improve efficiency of students attitude and emotive identification with subject content. The average score of knowledge mastery in the experimental group was 4.32, which was higher than that in the control group. This result can be viewed from two perspectives: First, the micro-project task itself has a knowledge integration function. Students must repeatedly recall and apply the knowledge they have learned as they complete the project. This "learning by doing" encourages in-depth processing of knowledge. Secondly, the multi-modal resources (video, VR,

case studies) provided by digital platforms help enrich students' cognitive experience and help visualize abstract concepts. The degree of ability transfer is a key indicator for evaluating the effectiveness of ideological and political education. It captures the awareness and the capacity of students to apply their ideological and political literacy in professional practice and in everyday life. The experimental group got a score of 4.08 on this dimension, which was

very high compared to the control group at 3.38. This indicates that through the micro-project-based teaching, students not only “know” the content of ideological and political education, but more importantly, students “know how to use” it. For example, students involved in the “Integrity and Ethics in Live-streaming E-commerce” project were able to proactively pay attention to and discuss professional ethics issues in the following professional training, and the integration of ideological and political literacy with professional skills. To examine the mediating effect of student participation on the relationship between micro-project-based learning and teaching effectiveness, the SPSS macro PROCESS developed by Hayes was used for mediation analysis. Teaching method (experimental group = 1, control group = 0) was used as the independent variable, total teaching effectiveness score as the dependent variable, and total participation score as the mediating variable. Pre-test scores and gender were controlled for. The results are shown in Table 3.

TABLE 3. Mediating effect analysis of participation between micro-project-based teaching and teaching efficacy

Effect type	Effect value	Boot standard error	BootLLCI	BootULCI	Relative effect proportion
Total effect	0.683	0.072	0.542	0.825	-
direct effects	0.124	0.089	-0.051	0.299	18.2%
Indirect effects	0.559	0.068	0.428	0.693	81.8%

Table 3 shows that the total effect value was 0.683, with a 95% confidence interval that did not contain 0, indicating that micro-project-based learning has a significant positive predictive effect on teaching efficacy. After adding the mediating variable, the direct effect decreased to 0.124, with a confidence interval that included 0 (ranging from -0.051 to 0.299), indicating that the direct effect was not significant; while the indirect effect value was 0.559, with a confidence interval that did not contain 0, indicating that the indirect effect was significant. This result indicates that student participation plays a complete mediating role between micro-project-based learning and teaching efficacy, that is, micro-project-based learning enhances teaching efficacy entirely by increasing student participation. The indirect effect accounted for 81.8% of the total effect, further confirming the key mediating role of participation.

This finding has important theoretical significance and practical implications. It reminds educators: when designing micro-project teaching, they should not only focus on the novelty and interest of the project tasks themselves, but also whether these tasks truly stimulate students' in-depth participation; increasing participation is both a goal and a means. The “fully mediated” conclusion of this study is based on a specific model specification, namely, we examined the path of teaching intervention → student participation → teaching effectiveness and found that the direct effect was not significant. This result does not exclude the possibility that other potential variables (such as teacher charisma, classroom atmosphere, social environment, etc.) may also have an independent impact on teaching effectiveness, nor

does it mean that student participation is the only path through which teaching intervention affects teaching effectiveness. On the contrary, it emphasizes that within the teaching intervention framework of this study, stimulating student participation is a key, even necessary, central link in transmitting teaching effectiveness.

V. CONCLUSION

This study leverages digital technology to construct a micro-project teaching model for ideological and political courses, integrating technical simulations and high-performance engineering to align with the practical cognitive characteristics of higher vocational students. Through empirical research, the study tests the impact of this material-driven pedagogical model on student participation and teaching effectiveness, demonstrating how the structural logic of industrial can ground abstract theoretical concepts. The research has certain limitations: the experimental period is eight weeks and only covers two teaching modules. The long-term changes in student participation and teaching effectiveness need to be followed up and studied; the research object is limited to one higher vocational college, and the sample representativeness is limited. Follow-up research can expand the sample scope and conduct multi-center comparative studies; the functions of the digital platform are still being improved, and the accuracy of some data collection needs to be improved. Future research can further explore the differential impact of micro-projects centered on high-performance technical on student engagement, while investigating the moderating role of individual characteristics in the formation of student participation. By examining how specific professional backgrounds influence the mastery of complex fiber-reinforced structural logic, the study will provide deeper insights into tailoring material-driven pedagogical models for diverse learning styles.

AUTHOR CONTRIBUTIONS

Shuqi Tang designed, collected and analyzed the data, and drafted the manuscript. Shuqi Tang conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Shuqi Tang participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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HUMAN RESEARCH SUBJECTS

This study was approved by the Ethics Committee of Weihai Ocean Vocational College, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

REFERENCES

- [1] X. Wang, S. Zhao, J. Liu, et al., "College music teaching and ideological and political education integration mode based on deep learning," *Journal of Intelligent Systems*, vol. 31, no. 1, pp. 466-476, 2022, DOI: 10.1515/jisys-2022-0031.
- [2] F. Qi, Y. Chang, K. Ramesh, et al., "Online and offline teaching connection system of college ideological and political education based on deep learning," *Progress in Artificial Intelligence*, vol. 12, no. 2, pp. 163-174, 2023, DOI: 10.1007/s13748-021-00268-w.
- [3] Y. Guan, "Research on the collaborative path of integrating ideological and political content into college physical education teaching," *Curriculum and Teaching Methodology*, vol. 6, no. 10, pp. 130-134, 2023, DOI: 10.23977/curtm.2023.061020.
- [4] Q. Deng, C. Zhang, W. Yu, et al., "A teaching method of ideological and political education in colleges and universities based on knowledge graph," *Advances in Educational Technology and Psychology*, vol. 7, no. 6, pp. 15-19, 2023, DOI: 10.23977/aetp.2023.070603.
- [5] T. Wang, "The Innovation of Teaching Management in Promoting and Exploring the Reform of Ideological and Political Education in Higher Education," *Curriculum and Teaching Methodology*, vol. 6, no. 13, pp. 23-27, 2023, DOI: 10.23977/curtm.2023.061305.
- [6] W. Liu, "Balanced scheduling method of ideological and political teaching resources based on cluster analysis algorithm," *International Journal of Reasoning-based Intelligent Systems*, vol. 17, no. 1, pp. 1-8, 2025, DOI: 10.1504/IJRIIS.2025.145056.
- [7] N. Zhang and J. Wang, "Exploring the Practical Pathways of Integration Between College English Teaching and Ideological and Political Education Under the Concept of High-Impact Teaching," *The Educational Review, USA*, vol. 9, no. 4, pp. 460-465, 2025, DOI: 10.26855/er.2025.04.011.
- [8] Y. Li and Y. Li, "Research on teaching Quality Improvement Path of ideological and political course in universities," *Teacher Education and Curriculum Studies*, vol. 8, no. 3, pp. 117-120, 2023, DOI: 10.11648/j.tecs.20230803.11.
- [9] H. Wang, "Construction of ideological and political cognition teaching mode in English courses in higher vocational colleges," *Methods*, vol. 6, no. 18, pp. 1-6, 2023, DOI: 10.25236/FER.2023.061801.
- [10] X. Zhu, Z. Li, Y. Liu, et al., "Research on ideological and political teaching of university physical education curriculum based on OBE concept," *Curriculum and Teaching Methodology*, vol. 6, no. 17, pp. 47-54, 2023, DOI: 10.23977/curtm.2023.061709.
- [11] L. Zhang, "Ideological and political empowering english teaching: ideological education based on artificial intelligence in classroom emotion recognition," *International Journal of Computer Applications in Technology*, vol. 71, no. 3, pp. 265-271, 2023, DOI: 10.1504/IJCAT.2023.132103.
- [12] Z. FU and C. XU, "Curriculum-based ideological and political education and college english teaching-based on urban development," *Journal of Literature and Art Studies*, vol. 14, no. 7, pp. 632-635, 2024, DOI: 10.17265/2159-5836/2024.07.016.
- [13] J. Lv, W. Liu, L. Bai, et al., "Practical Research on the Integration of Ideological and Political Education into Mathematics Teaching in Higher Vocational Colleges," *Advances in Vocational and Technical Education*, vol. 6, no. 4, pp. 161-165, 2024, DOI: 10.23977/avte.2024.060422.
- [14] Y. Zhang and H. Guo, "Research on the innovation of ideological and Political Education Mode and the Integration of Intelligent Teaching Systems in the Digital Era," *J. COMBIN. MATH. COMBIN. COMPUT*, vol. 12, no. 7, pp. 2329-2344, 2025, DOI: 10.61091/jcmcc127b-132.