Construction and Empirical Research on the Design Model of "One Course with Multiple Teachers" for Applied Universities under the Industry-Education Integration + Digitization

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Abstract. Applied universities bear the important mission of cultivating high-quality applied and innovative talents adapted to industrial needs and exploring the design of "one course with multiple teachers" mode under the digital technology of education is of great significance for promoting its teaching reform and improving the quality of education. This paper tried to construct and prove the design model of "one course with many teachers" under the integration of industry and education + education digitalization and found that the constructed model has strong practical significance.

Keywords: industry-education integration; digitalization of education; applied universities; one course with multiple teachers(multi-teacher); model construction

1 Introduction

Several Opinions on Deepening the Integration of Industry and Education states that "deepening the integration of industry and education, and promoting the organic convergence of the education chain, talent chain with the industrial chain and innovation chain are the urgent requirements of the current promotion of structural reform on the supply side of human resources." "Gradually increase the degree of participation of industrial enterprises in running schools, and comprehensively implement collaborative education between schools and enterprises." "Highlighting the integration of industry and education" has gradually become an important issue in the field of higher education. 2022, the Ministry of Education officially launched the "Education Digitalization Strategy Action". In this context, the teaching mode of applied universities is also constantly exploring and innovating. Among them, "one course with multiple teachers", as a new type of student-centered teaching mode that focuses on practical teaching, has attracted extensive attention and research.

However, there are relatively few studies on this teaching mode. Sporadic literature mainly focuses on the teaching exploration of "one course with multiple teachers" in

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specific courses [1-7], Liu Xiaoxu (2023) explored the core elements of the teaching mode of "one course with multiple teachers" and its operation mechanism in the context of curriculum ideology and politics [8], Pei Dongxia et al. (2013) and Sun Zijun et al. (2014) respectively analyzed the application of "one course with multiple teachers" from e-commerce majors and ideological and political education majors [9-10], but there is still a gap in the results of researching this teaching mode from the perspective of applied universities under the integration of industry and education + digitization, so it is necessary to carry out in-depth research on it so as to better guide practice and improve teaching and learning.

2 Relevant Overview

2.1 Industry-education integration

Industry-education integration refers to the close cooperation between industry and education to enable students to better integrate into the actual working environment and to improve their practical and problem-solving abilities through the co-development of curricula and joint practical projects.

2.2 Digitalization of education

Digitalization of education refers to the use of information technology and digital tools to change the way and method of education, and realize the digitalization, intelligence, and personalization of the education process. With the strategic decisions of Network Power and Digital China, education digitization has become an inevitable choice, and data collection and analysis using digital technology can provide a scientific basis for teaching improvement.

2.3 "One course with multiple teachers (Multi-teacher)" teaching model

The teaching mode of "multi-teacher" means that in a course, a team of teachers composed of professionals from different fields participates in the teaching process and undertakes the teaching tasks together. Under the industry-education integration + digitalization, the " multi-teacher" is an innovative teaching mode that combines education and industry, aiming to provide students with multi-perspective, broad knowledge and close-to-actual intelligent teaching experience through the in-depth cooperation and synergy between teachers and enterprise professionals, and the help of education digital technology by each teacher according to his/her own field of specialization and practical experience. intelligent teaching experience that is close to the reality.

3 Constructing the design model of "multi -teacher" in applied universities

Under the integration of industry and education + digitalization, the teaching design of "one course with multiple teachers" is mainly outlined in four aspects: teaching team building, course content design, teaching activity design, and evaluation and feedback mechanism establishment, so the basic model is set as follows:

$$EMTTM = \beta_1 TTBS + \beta_2 CCDS + \beta_3 TADS + \beta_4 EFMES$$

Which:

$EMTTM = Effectiveness\ of\ the\ "Multi-teacher"\ Teaching\ Model$
$TTBS = Teaching\ Team\ Building\ Score$
$CCDS = Course\ Content\ Design\ \ Score$
$TADS = Teaching\ Activity\ Design\ \ Score$
$EFMES = Evaluation\ and\ Feedback\ Mechanism\ Establishment\ \ Score$
$\beta_i = Percentage\ impact\ of\ each\ factor\ on\ effectiveness$

3.1 Teaching Team Building

In the "multi-teacher" design, the formation of a team of teachers is crucial. Team members should include school teachers, business elites and industry experts, each of whom has different roles and responsibilities to ensure the professionalism and teaching ability of the mentor team.

The scoring model of the teaching team to measure the formation of "multi-teacher" is set as follows:

$$TTBS = a_1 TS + a_2 DR + a_3 CP + a_4 TT$$

Which:

$TTBS = Teaching\ Team\ Building\ Score$
$TS = Teacher\ Sources$
$DR = Division\ of\ Responsibilities$
$CP = Cooperative\ Partnerships$
$TT = Teacher\ Training$
$a_i = Weight\ of\ each\ factor\ affecting\ the\ building\ of\ teaching\ team$

1) Introduce teachers from different subject areas. In the design of "multi-teacher", teachers from different disciplines can be introduced to teach together. Through interdisciplinary teaching, students can broaden their knowledge horizons and develop their comprehensive thinking and problem-solving abilities.

2) Clarify roles and responsibilities. School teachers are responsible for teaching theoretical knowledge, enterprise tutors are responsible for guiding students' practical projects and industry internships, and industry experts are responsible for introducing students to industry dynamics and practical experience in the division of roles. Team members should have good communication and cooperation ability among themselves, and work together to formulate teaching objectives and teaching plans.

3) Establish close cooperative relationship. Teacher team members should establish close cooperative relationships with each other. Utilizing digital technology, regular online meetings and cloud discussions are held to jointly develop teaching objectives and teaching plans, share teaching resources and experiences through online communities and collaborative platforms, and form a community of mutual learning and support.

4) Strengthening Teacher Training. To ensure the professional level and teaching ability of the teacher team, teacher training should be strengthened. More online teacher training should be organized so that teachers can master the use of digital teaching tools and platforms and help the teacher team to continuously improve their teaching level.

3.2 Course Content Design

Under the integration of industry and education + digitalization, course content design is the core of the design of "multi-teacher". The overall design should be practical and digitally oriented. Teacher teams should consider the actual needs of the industry, make full use of digital technology, identify the core knowledge and skills of the course, and integrate them with practical cases and project tasks.

The score model of the "multi-teacher" course content design is set as follows:

$$CCDS = b_1 CKS + b_2 TPID + b_3 PPDR + b_4 IPI$$

Which:

$CCDS = Course\ Content\ Design\ Score$
$CKS = Core\ Knowledge\ and\ Skills$
$TPID = Theoretical - practical\ Integration\ dDegree$
$PPDR = Practical\ Project\ Design\ Reasonableness$
$IPI = Industry\ Practice\ and\ Internship$
$b_i = Weight\ of\ each\ factor\ affecting\ the\ design\ of\ course\ content$

1) Identify core knowledge and skills. Using big data technology, the teacher team collects, mines, and analyzes the actual needs of the industry to determine the core knowledge and skills of the curriculum. These knowledge and skills should be closely related to the students' future career development and be able to meet the industry's demand for talents.

2) Combination of theoretical knowledge and practice. The course content design should fully combine theoretical knowledge and practical application. School teachers, enterprise teachers and industry experts can design the specific content through online seminars, remote cooperation documents, etc. School teachers are responsible for the theoretical knowledge, and enterprise teachers and industry experts are responsible for the design of the practical projects integrated with them, to achieve the purpose of learning to use.

3) Practical project design. The design of practical projects is an important link in the design of "multi-teacher". Teacher teams can design challenging and practical projects according to the course objectives and the actual situation of students, with full

consideration of students' professional strengths and interests, and matching with industrial needs. Through practical projects, students can apply what they have learned to solve practical problems and enhance their practical and innovative abilities.

4) Industry practice and internship. To let students better understand the industry dynamics and actual working environment, the course content design can include industry practice and internship. Students can be arranged to conduct field trips, internships or participate in industry projects, or digital technology can be used to design virtual practice and simulation situations, so that students can perform practical operations and experiences in a virtual environment.

3.3 Teaching Activity Design

Teaching activities are the key to the design of "multi-teacher". With the digitalization of education, we can design various practical teaching activities, such as online group discussions, virtual experiments, simulation software, online collaboration platforms, etc., to implement smart teaching in various forms, increase the practicality and digitalization of the curriculum, and improve the quality of education. Teaching activity design score can be measured in terms of the number of teaching activities used and the suitability of teaching activity selection.

$$TADS = c_1 NTAU + c_2 STAS$$

Which:

$TADS = Teaching\ activity\ design\ score$

$NTAU = number\ of\ teaching\ activities\ used$

$STAS = suitability\ of\ teaching\ activities\ selected$

$c_i = Weight\ of\ each\ factor\ affecting\ the\ design\ of\ teaching\ activities$

3.4 Evaluation and Feedback Mechanism Establishment

Under the digitalization of education, the construction of a digital assessment and feedback mechanism for "multi-teacher" is an indispensable link. Teacher teams should make full use of digital technology to design diversified intelligent assessment and feedback methods, track and analyze students' learning through learning data analysis tools, monitor learning effects in real time based on instant feedback data, and adjust and optimize course content and improve teaching methods in a timely manner. Under the integration of industry and education, the focus of assessment should be on students' application of theoretical knowledge and the development of problem-solving ability.

Based on the above analysis, the design model of "multi-teacher" under the integration of industry and education + digitalization can be determined as follows:

$$EMTTM = \beta_1(a_1 TS + a_2 DR + a_3 CP + a_4 TT) + \beta_2(b_1 CKS + b_2 TPID + b_3 PPDR + b_4 IPI) + \beta_3(c_1 NTAU + c_2 STAS) + \beta_4 EFME$$

which:

$$a_1 + a_2 + a_3 + a_4 = 1;\ b_1 + b_2 + b_3 + b_4 = 1;\ c_1 + c_2 = 1$$

$$\beta_1 + \beta_2 + \beta_3 + \beta_4 = 1$$

4 Evidence based design model of "multi-teacher" in applied universities

Taking an applied university-Guangdong University of Science and Technology (GDUST) as an example, selecting representatives of our teachers, school supervisors, school leaders, and experts from enterprises and industries to form an expert team, creating a scoring tool using digital technology such as an online survey tool or a questionnaire platform, scoring the importance of each factor online through the expert scoring method (scoring standards are shown in Table 1), automatically collecting the expert scoring data, and repeating the operation to ultimately determine the importance scores of each factor using the AHP as shown in Table 2.

Table 1. 1-9 Scaling methods

Scale	Meaning
1	The two elements are equally important compared to each other
3	The former is slightly more important than the latter when compared to the latter
5	The former is significantly more important than the latter when compared to the latter
7	The former is more strongly important than the latter when com-pared to the latter
9	The former is more important than the latter when compared to the latter
2、4、6、8	The middle value of the above adjacent judgments

Table 2. Weight of each factor

Weight of each factor		value		Weight of each factor		value	
β_1	a_1	0.2766	0.2571	β_2	b_1	0.2685	0.25
	a_2	0.2553			b_2	0.2416	
	a_3	0.2340			b_3	0.2483	
	a_4	0.2341			b_4	0.2416	
Weight of each factor		value		Weight of each factor		value	
β_3		0.2429	0.2429	β_4		0.25	
		0.2429					

As a result, the design model of "multi-teacher" in GDUST can be determined as follows:

$$EMTTM = 0.07111TS + 0.06564DR + 0.06016CP + 0.06019TT + 0.06713CKS + 0.0604TPID + 0.06208PPDR + 0.0604IPI + 0.11132NTAU + 0.13158STAS + 0.25EFME$$

According to the model established above, the evaluation committee of GDUST was firstly formed, and then digital evaluation technology was utilized to evaluate the quality of teachers' sources (TS), teachers' division of responsibilities (DR), teamwork (CP), teachers' training (TT), and the design of core knowledge and skills (CKS), The integration of theory and practice (TPID), quality of practical program design (PPDR), industry practice and internship design (IPI), number of teaching activities adopted

(NTAU), suitability of selected teaching activities (STAS), and establishment of evaluation and feedback mechanism (EFME). "Third, based on the final scores of these 11 aspects, substituting into the above equation, we get the score of each " multi-teacher" design, and finally, we can make internal or external horizontal comparisons of the "multi-teacher" of GDUST. Finally, it is possible to make horizontal comparisons of GDUST's " multi-teacher" within and outside the university, or to track the design of a specific "multi-teacher" each semester, to analyze its development vertically and to summarize the lessons learned.

5 Conclusion

The conclusions of this paper mainly include three aspects. First, this paper defined the connotation of industry-education integration, education digitization and "one course with multiple teachers". Second, based on 11 factors in the four aspects, this paper constructed a design model of "one course with multiple teachers" for applied universities. Third, this paper proved that the constructed model has strong practical significance. Taking Guangdong University of Science and Technology as an example, the empirical results showed that the outcomes calculated by the model are reasonable and fair, and the outcomes calculated by the model can be compared horizontally and vertically, which can help the applied universities to evaluate and improve the teaching mode, and to improve the quality of cultivating high-caliber talents in line with the needs of the industry.

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