How Does School Education Affect the Learning Engagement of Vocational School Students?

—— Path Analysis based on Information Technology Development

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Abstract. In the context of high-quality development of vocational education, measures are proposed to integrate modern information technology and artificial intelligence into the reform of vocational schools to improve the learning engagement of vocational school students. This study explores the impact of school factors on the learning engagement of vocational school students and investigates the situation of 12 vocational schools in Dongguan, Guangdong Province through a questionnaire survey. The study constructed a theoretical model to verify the impact of five school factors, including school hardware facilities, school atmosphere, teacher teaching ability, teacher investment, and teacher attention, on the learning engagement of vocational school students. Based on the research results, suggestions are made for vocational schools to create intelligent classrooms, enhance teachers' information literacy, and improve campus digitalization, in order to boost students' learning outcomes and professional competitiveness, and lay a solid foundation for vocational education's future development.

Keywords: learning engagement; Secondary vocational education; promotion of information technology; Reform of educational methods;

1 Introduction

Paying attention to students' learning engagement is an inherent requirement for the high-quality development of vocational education and the improvement of talent cultivation quality[1]. Currently, vocational education in China has entered a stage of high-quality development, and stimulating students' learning engagement and unleashing their learning potential has become the key to the development of vocational schools. With the advancement of educational informatization, promoting the transformation of vocational education informatization has become an important entry point for optimizing school functions and promoting students' learning engagement. The Report on the Development of Vocational Education in China points out that vocational education should closely focus on the forefront of digital technology, accelerate professional upgrading and transformation, and enhance the ability to culti-

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vate digital skilled talents. Previous studies have mostly focused on the field of ordinary primary and secondary schools, with relatively little research on vocational education and a lack of solid empirical analysis. Therefore, focusing on the impact of vocational school education on students' learning engagement from the perspective of informatization has important practical significance.

Based on this, this study uses questionnaire surveys and path analysis to collect data and reveal causal relationships among factors.From the perspective of information technology development, five factors including school hardware facilities, teacher teaching ability, and teacher investment are selected for examination. These factors not only cover traditional teaching resources, but also include the impact of information technology construction on vocational school education. Through research, the aim is to provide a solid empirical foundation for vocational school education and promote high-quality development of vocational education.

2 Analysis of the Current Situation of Learning Engagement among Vocational School Students

2.1 Learning Engagement Framework

Schaufeli first introduced the concept of "learning engagement", emphasizing its importance as a key psychological state closely linked to learning activities[2]. Since the 1990s, research on student engagement has involved different aspects such as behavioral engagement, emotional engagement, and cognitive engagement, gradually forming a basic structure of three aspects[3]. Referring to this research framework, this study will examine the learning engagement of vocational school students from three dimensions: learning behavior engagement, learning emotional engagement, and learning cognitive engagement.

2.2 Analysis of the Current Situation of Learning Engagement Among Vocational School Students

This study is based on a survey of 12 secondary vocational schools in Dongguan City, Guangdong Province. By referring to the research on the three dimensions of learning engagement in the China College Student Survey (CCSS) and combining the characteristics of actual secondary vocational student groups, the study operationalized learning behavior engagement, learning emotional engagement, and learning cognitive engagement into a learning engagement scale. On average, 1013 valid samples were collected from the 12 schools.

The study transforms learning behavior into 30 questions, including 'I can often discuss learning issues with classmates in my spare time'; Transforming emotional investment in learning into 11 questions such as' I am very satisfied with my current learning life '; Transforming cognitive investment in learning into 13 questions such as' Learning can bring me tremendous personal growth '. After verification, the Cronbach's alpha coefficient of the scale is 0.863, and the Cronbach's alpha coeffi-

cients of the three dimensions are 0.980, 0.968, and 0.980, respectively. The KMO values are 0.980, 0.955, and 0.968, indicating that the scale has good internal consistency and correlation, and the data credibility is high. The significance of Bartlett's sphericity test is less than 0.05, and the sphericity hypothesis is rejected. There is a correlation between variables, making factor analysis suitable.

After preprocessing the data, combined with the Likert five point scale, the measurement data ranges from 1 to 5, representing from very disagree to very agree. Referring to the selection situation of vocational school students, a descriptive analysis is conducted on their level of learning engagement. The higher the score, the better the student's learning engagement. The analysis of Table 1 shows that the average learning engagement of vocational school students is 3.4364, with significant room for improvement. Among them, the level of learning behavior engagement is significantly lower, while the emotional and cognitive engagement in learning is relatively higher.

Learning behavior engagement encompasses students' reactions in the classroom and their self-directed learning after class. The low level of learning behavior engagement among vocational school students also reflects to some extent their shortcomings in learning. Most vocational school students have a poor cultural foundation, and the standardized teaching in vocational schools cannot meet their learning needs. This may lead to a vicious cycle of "poor foundation - disinterest in learning/inability to learn - even worse foundation" in the learning process, resulting in a decrease in the level of learning behavior engagement. In addition to personal factors of vocational school students, the school learning environment is also a key factor in ensuring smooth learning. However, some vocational schools may have deficiencies in technical support, such as incomplete service systems and unstable facilities, which can affect students' learning experience and behavioral engagement.

Table 1. Analysis of Learning Engagement of Vocational School Students

variable	Number	Minimum	Maximum	Mean
Behavior investment	1013	1.00	5.00	3.3268
Emotional investment	1013	1.00	5.00	3.4826
Cognitive investment	1013	1.00	5.00	3.4998
Learning engagement (total)	1013	1.00	5.00	3.4364

2.3 Differential Analysis of Learning Engagement

This study compares the differences in learning engagement at the school level by analyzing the differences in geographical location and school level among different schools. The results showed that there was little difference in learning engagement between different geographical locations, while there was a significant difference in learning engagement among schools of different levels.

Table 2. Analysis of Differences in Learning Engagement among Vocational School Students from Different Geographic Locations.

variable	Number	Mean±SD	F	P
Central urban schools	340	3.3974±0.7739	1.377	0.241
Non central urban schools	673	3.4562±0.7422		

Table 3. Analysis of Differences in Student Learning Engagement at Different Levels of Schools.

variable	N	Mean±SD	F	P
National Key School	506	3.5376±0.69215	9.466	<0.001
Provincial key schools	333	3.3499±0.83767		
Non key schools	174	3.3077±0.71539		
National key vs provincial key				<0.001
National key vs non key				<0.001
Provincial key vs non key				0.546

From Tables 2 and 3, we can see that there is no significant difference in the level of learning engagement between schools in central urban areas and those outside of central urban areas. In terms of school resources, the level of learning engagement of students in national key vocational education schools in Dongguan City is higher than that of students in provincial key and non key vocational schools. The ANOVA test shows that the significance of different school resources on students' learning engagement is significant, and the difference between national key schools and provincial key and non key schools is less than 0.001. Research has found that although there are differences in learning foundations and motivation among students in the three types of schools, these factors may affect the level of learning engagement of vocational school students. However, national key vocational schools have a more complete management system and more resource investment, which can provide students with a better teaching environment and more learning opportunities. Though provincial key and non-key vocational schools may have good teaching quality, they still can't match national key schools in some aspects.

3 Analysis of the Impact of School Factors on Learning Engagement

3.1 School Factor Framework

Existing scholars have developed a relatively mature factor analysis framework for studying factors that affect learning engagement, including personal factors, family factors, and school factors. Bronfenbrenner's ecological development theory emphasizes that developing individuals are nested within a series of interdependent environments, and for student development, the school environment is crucial. Based on the current situation and data collection of vocational schools in China, and referring to existing research frameworks, this article selects five aspects of school factors,

including school hardware facilities, school atmosphere, teacher teaching ability, teacher investment, and teacher attention, to examine the basic status of vocational schools. Among them, school hardware facilities include basic school buildings, equipment, as well as information technology hardware facilities such as computers and networks; The school atmosphere refers to the cultural and institutional environment, academic atmosphere, and school spirit of the school, including the institutional guidance for information construction and the cultural atmosphere for information development; The teaching ability of teachers not only includes their basic teaching skills, but also encompasses their ability to apply information technology in teaching design, resource integration, and classroom interaction; Teacher investment refers to the software and hardware investment of teachers in teaching, including the time and energy invested by teachers in information-based teaching, including learning new technologies, creating digital teaching resources, etc.

3.2 Basic Status Analysis of Vocational Schools

Based on the analysis of the basic situation of vocational schools, Table 4 shows that the overall level of vocational schools perceived by students is 3.4363, which is in the middle range. The construction of various aspects has not yet reached the ideal requirements and still has room for improvement. Among them, the level of hardware facilities and teacher attention in the school is relatively low. In terms of school hardware facilities, the incomplete construction of information infrastructure in some schools limits the effective application of information teaching methods and affects students' level of learning engagement. In terms of teachers, the overall level of information technology teaching ability of vocational school teachers needs to be improved. After on-site investigation and research, it was found that some teachers have weak information awareness and insufficient mastery and application ability of modern educational technology, which hinders the comprehensive promotion of information-based teaching in secondary vocational schools. In terms of school atmosphere, the application of information technology in campus culture construction is not deep enough. Although some schools have begun to use information technology to carry out moral education work, overall, the campus information atmosphere has not yet formed, and teachers and students have not fully developed the habit of using information tools, which makes the promotion of information technology teaching lack necessary support and motivation.

Table 4. Basic Status Analysis of Vocational Schools.

variable	Number	Mean	Standard Error of Mean
School hardware facilities	1013	3.3756	0.03077
School atmosphere	1013	3.4674	0.03053
Teacher Teaching Ability	1013	3.5021	0.02977
Teacher investment	1013	3.5064	0.03081
Teacher Attention	1013	3.3297	0.03004
School factors (total)	1013	3.4363	0.02803

3.3 Establishing a Model of the Impact of School Factors on Learning Engagement

To study the impact of five factors on students' learning engagement in vocational schools, this article uses a multivariate linear model for analysis, which is represented as follows:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \varepsilon \quad (1)$$

In the model, the dependent variable Y represents the level of student learning engagement, and the independent variable$x_i$represents the key indicators of school factors. In this paper, five indicator dimensions are established: school hardware facilities, school atmosphere, teacher teaching ability, teacher engagement, and teacher attention. $\beta_0$expressed as the expected value of learning engagement when the school factor is 0. β_i(i=1, 2, 3, 4, 5) represents the regression coefficient, ε is a random error, and represents the parts that the model cannot explain. The regression results obtained are shown in Table 5.

Table 5. Regression Results of the Impact Model of School Factors on Learning Engagement

Model	Unstandardized Coefficient		Standardized Coefficients	t	Significance	VIF
	B	Standard Error of Mean	Beta			
(Constant)	0.918	0.47		19.632	0.000**	
School hardware facilities	-0.028	0.028	-0.036	-1.009	0.313	5.336
School atmosphere	0.231	0.027	0.298	8.424	0.000**	5.160
Teacher's teaching ability	0.249	0.034	0.313	7.218	0.000**	7.756
Teacher investment	0.221	0.025	0.281	8.833	0.000**	4.168
Teacher attention	0.058	0.029	0.076	2.047	0.041*	5.697
Adjusted R-squared				0.755		
Durbin-Watson statistic				2.057		

Note: * indicates P<0.05, * * indicates P<0.01

According to the analysis of Table 5, after data adjustment, the R^2 value is 0.755, indicating a good fitting relationship. The DW value is 2.057, and the autocorrelation of the variables is not severe. The residual distribution in Figure 1 is close to a normal distribution. The school factor has a significant positive effect on students' learning engagement, confirming George Ku's emphasis on the close relationship between school factors and students' learning engagement in the theory of learning engagement. This indicates that schools need to actively support and encourage students to participate in effective learning activities from multiple aspects, so that students can invest more energy in learning, improve learning quality, and thus increase learning engagement. Teacher teaching ability (0.249), school atmosphere (0.231), and teacher

engagement (0.221) have a more significant positive impact on students' learning engagement, while teacher attention (0.058) has a positive impact. The school hardware facilities (-0.036) are the basic conditions for learning, but their impact on the learning engagement of vocational school students is relatively weak. This may reflect that the utilization rate of hardware equipment related to vocational school teaching is not high, and its effectiveness isn't fully utilized.

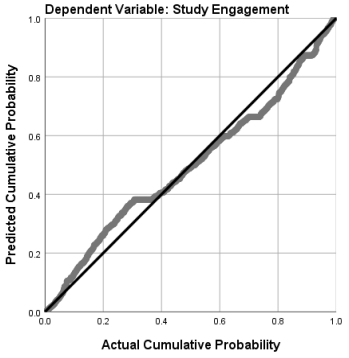

Fig. 1. Normal p-p plot of residual regression analysis of school factors on learning engagement.

4 Analysis of Research Results

4.1 Student Level: Weak Self-Efficacy in Learning

Vocational school students generally have weak self-efficacy in learning, mainly due to poor study habits in the early stages and the impact of failing the middle school entrance examination. After entering vocational school, students with weak foundations face increased difficulty in learning complex professional courses, and their self-efficacy further decreases. However, information-based teaching can stimulate students' learning engagement and self-efficacy by enhancing their sense of context and participation.

The author conducted interviews and surveys with students from vocational schools during the research process, and observed and recorded their classrooms through the school monitoring platform. It was found that most students lack sufficient learning enthusiasm in the traditional classroom mode. In the classroom observation of a certain finance class, the author found that only 9 out of 57 students could fully devote themselves, 16 could persist for half of the class, 7 occasionally devoted themselves, and as many as 25 students did not fully devote themselves (such as sleeping or chatting throughout the class), nearly half of the class. In another information-based teaching class relying on the teacher's practical studio, students in the same class performed significantly differently. In a favorable information environment, teachers adopt task-based teaching, allowing students to directly experience the real communication and operation of work positions. The students' sense of learning immersion is significantly enhanced, and 55 people can fully immerse themselves,

even unwilling to stop learning after class. Students believe that this teaching method is "cooler" and "more meaningful", in sharp contrast to the "boring" and "unproductive" aspects of traditional classrooms, indicating that information-based teaching effectively mobilizes students' intrinsic motivation.

From this, it can be seen that relying on the information technology teaching environment and its supporting teaching methods, students' potential kinetic energy can be well stimulated, and their self-efficacy can be effectively improved. However, in reality, the information construction level of many vocational schools is difficult to support this improvement. Some vocational schools have weak information infrastructure, limited opportunities for students to use information technology equipment, and uneven quality of existing equipment, which all restrict the realization of digital empowerment. Research has shown that students who actively participate in the classroom typically have higher learning motivation, better learning strategies, and stronger self-efficacy [4], while the lack of educational informatization makes it difficult for students to obtain personalized learning experiences through information technology, thus restricting the improvement of their self-efficacy.

4.2 Teacher Level: Limited Teacher Support Capacity

In vocational education, the teaching ability of teachers has a significant impact on students' learning engagement. Research shows that the coefficient of influence (β_3=0.313) indicates that teachers' teaching ability directly affects classroom teaching level and students' learning outcomes. The interview found that students have different feedback on teachers' teaching abilities, and some teachers are willing to provide positive support for students' growth and actively improve their teaching effectiveness; Some teachers also lack reverence for teaching, reject teaching innovation, have poor teaching effectiveness, and find it difficult to stimulate interest. In interviews with vocational school teachers, the author observed that young teachers, especially new hires, are often willing and willing to make more and bolder attempts in information-based teaching. A young teacher A said that trying new technologies and methods makes them "more accomplished", and they also want to provide personalized teaching for students. Despite failures, he is still willing to explore, which is his career growth path. On the other hand, many older teachers generally hold a negative or even resistant attitude towards information-based teaching. They can be divided into two categories: one does not reject information-based teaching, but believes that new technologies are difficult to learn and schools lack training support, so they give up trying; Another type despises information-based teaching, believing it to be a "facade" with no practical significance. During the interview, a middle-aged teacher, B (52 years old), showed obvious impatience and even left midway, demonstrating significant emotional and cognitive rejection.

It can be seen that in the face of the challenges of information-based teaching, different teachers exhibit significant differences in cognition, emotion, and even practice, which affect students' learning experience and effectiveness. Therefore, comprehensively enhancing the information technology teaching ability of vocational school teachers, especially helping older teachers adapt to new teaching models and trans-

form their inherent teaching thinking and concepts, is the key to improving students' learning engagement and effectiveness.

4.3 School Level: Teaching Conditions Fail to Meet Needs

Teaching conditions are the prerequisite for teaching quality. With the advent of the information age, teaching methods are constantly upgrading, and the integration of modern information technology and teaching resources is deepening. However, some vocational schools have not kept up with the progress, and their teaching tools in theoretical courses are still limited to computers and multimedia projections. Teachers are unable to provide in-depth teaching demonstrations, and theoretical learning cannot lay a solid foundation for practical courses, resulting in poor learning outcomes for students.In addition, research has found that school atmosphere significantly impacts vocational students' learning engagement. However, some vocational schools lack effective communication platforms, which limits teacher-student interaction, hinders students' potential development, and restricts the improvement of learning engagement.

5 Solution Measures

5.1 Classroom Level: Cultivate Students' Subjective Consciousness Through Smart Classroom

Smart classroom is a comprehensive set of teaching and learning activities generated through the all-round interaction between teachers, students, and technology in a smart learning environment. Its core feature is that it can achieve teaching interaction that is difficult to achieve in traditional classrooms[5]. Through the interaction mechanism of human machine object communication, a three-stage participatory learning mechanism is constructed before, during, and after class to provide data support for teaching. Before class, use the micro lesson system to build an "information framework" in a gamified, activity-based, and operational manner, in line with the learning preferences of vocational school students, explore cognitive boundaries, and tap into students' potential. In class, modern IoT technology is used to build an intelligent classroom, integrating the advantages of offline teaching and online learning. Students have more courage to ask questions, share, and participate in group discussions on digital platforms, achieving full participation and ideological collision. Teachers respond to questions through real-time feedback and use teaching tracking systems to record learning behavior, analyze learning outcomes, and achieve targeted learning situation analysis. After class, students' learning outcomes are evaluated through intelligent analysis. Based on their learning progress and personalized characteristics, the intelligent task system is used to push learning resources and suggestions to assist students in self-directed learning. The entire process allows students to clearly "see" the trajectory of academic progress, enhance their self-efficacy, and thus improve their level of learning engagement.

5.2 Teacher Level: Empowering Teaching Quality Improvement with Information Literacy

With the integration of virtual reality and artificial intelligence technology into teaching, and the deep integration of information technology and education, the era of "artificial intelligence+education" is approaching, and information literacy has become an essential quality for teachers' profession[6]. In this context, the information technology teaching ability of teachers is particularly important, which is essentially the integration of modern technology, education, and subject content knowledge, namely "Technology Pedagogical And Content Knowledge" (TPACK)[7]. Empower digital education and cultivate "Double-qualified" teacher. To enhance the information technology teaching ability of vocational school teachers, it is necessary to start from two aspects: ability and emotion. At the level of ability, we will carry out comprehensive operational improvement, organize teachers to regularly participate in information technology and educational technology training, encourage the sharing of successful cases, use information technology tools to enrich the classroom, and improve students' concentration. On the emotional level, establish teachers' identification with information technology teaching, let them feel the power of information technology, cultivate their emotional attitude towards embracing information technology, enhance professional sensitivity, actively explore the potential of teaching information technology, and better play the role of the main body of information technology teaching.

5.3 School Level: Improving Teaching Environment Construction with Digital Technology

The improvement of teaching quality in vocational education majors and the optimization of campus digitalization level are complementary. Research suggests that all vocational education majors can improve the quality of classroom teaching and enhance the quality of technical training for vocational college students through information technology construction[8].Improving the digitalization level of campuses is an important measure for the construction of educational informatization. The school should ensure full coverage of high-speed Internet in the campus, and configure RFID, video surveillance and other sensing technology equipment to achieve intelligent attendance in classrooms and conferences, intelligent opening of the training building and automatic alarm for abnormal conditions, create a good learning atmosphere and ensure the learning environment of students. At the same time, establish a dedicated digital resource center to integrate network resources, screen suitable teaching resources and tools for vocational students, and use learning scenario recognition technology to diagnose learner characteristics, recommend resources, and improve teaching effectiveness.

6 Conclusion

This study deeply explores the impact of secondary vocational education school factors on the learning engagement of secondary vocational students, confirms the corre-

lation between secondary vocational school school factors and student learning engagement, and proposes a series of practical and feasible suggestions in the context of informatization, as shown in Figure 2.

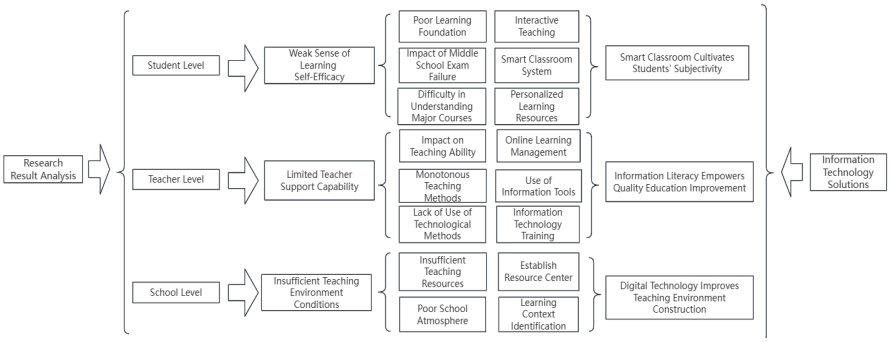

Fig. 2. Exploration of Informationization Path.

Through the construction of smart classrooms, the improvement of digital literacy of teaching staff, and the construction of information-based campuses, secondary vocational education schools can effectively improve teaching quality, enhance students' learning engagement, and cultivate high-quality talents who can adapt to future society and career development. Information technology construction is not only the introduction of technology, but also the innovation of educational concepts and teaching modes, laying a solid foundation for the sustainable development of secondary vocational education.

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