Teaching Reform and Practice of Task-Driven Approach Based on 'Modularization + Digitization' in Information Technology Fundamentals Course

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Abstract—With the continuous advancement of educational digitization, exploring blended learning and online teaching through the use of the Internet has become an inevitable trend in the reform of practice-oriented course instruction. Addressing issues such as the uneven computer application foundation of first-year students, limited class hours despite extensive course content, rapid development of information technology, and the limitations of traditional teaching methods and evaluation approaches. Following the educational principles of "student-centeredness, competency-based, and outcome-oriented," a questionnaire survey was conducted to understand students' learning foundations, assessments, and suggestions. Based on the fundamental, practical, and applied nature of the "Information Technology Fundamentals" course, an exploration was made into task-driven teaching reform using a "modularized and digitized" approach. The paper introduces the implementation of teaching reform from the perspectives of instructional goals, execution process, and assessment, highlighting the effects of the reform through theoretical assessments, online project practices, and survey questionnaires. Finally, the experience gained and the existing shortcomings of the reform are summarized.

Keywords-modularization; digitization; task-driven; SPOC; MOOC

1 Introduction

The information technology course is a compulsory basic course offered in the first semester of the freshman year for students in higher education institutions. It aims to establish a solid foundation of information literacy and cultivate students' awareness of information, computational thinking, digital innovation and development, and social responsibilities in the information society.The Report of the 20th National Congress of the Communist Party of China comprehensively coordinated and integrated education, science and technology, and talent development as a unified whole for the first time. It also included "promoting educational digitization" in the report for the first time [1].In the face of the digital age, education must adapt to social changes and accelerate its transformation to cultivate new generations capable of adapting to the future society. With the development of technologies

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such as cloud computing, big data, blockchain, and artificial intelligence, digital technology profoundly influences and changes human thinking, production, life, and learning methods. The maturity of network technology and the improvement of the online learning environment present numerous opportunities and challenges in terms of teaching content, modes, methods, and ways of learning and communication in the information technology basic course.

2 Learning analytics

With the rapid development of digital technology, the widespread popularization of personalized learning concepts, and the increasing demand for online learning, traditional offline teaching models are facing significant challenges and pressures for reform. To fully understand students' knowledge foundation, practical abilities, and learning needs, multiple surveys have been conducted since 2019 [2].

The results of the survey on "students' information technology proficiency before entering university" reveal that 83.16% of students have a certain level of information technology foundation and are familiar with computers. However, 16.84% of students have had minimal exposure to computers, lacking relevant foundational knowledge and experience, as shown in Table 1. Despite the internet access rate in independent schools in Guangdong Province already reaching 100% [3], and the continuous improvement in computer skills among incoming university students, some secondary schools still fail to adequately prioritize the education of students in information technology. This may lead to significant disparities in theoretical foundations and practical abilities among students.

Table 1 Information Technology Proficiency of Students Before Entering University

Options	Number	Percentage
Studied relevant courses	302	24.69%
Frequently use computers for learning or entertainment	715	58.46%
Almost first-time exposure to computers	206	16.84%

Regarding students' expectations for learning modes, according to the survey results, 70.07% of students prefer a blended learning mode that combines both online and offline methods. This mode allows for the integration of face-to-face interaction and the convenience of online resources, providing students with a more flexible and diverse learning approach. 22.01% of students prefer fully offline teaching. They believe that direct interaction with teachers and classmates helps them better understand and grasp knowledge while enjoying social experiences through in-person communication. Additionally, 7.92% of students prefer fully online teaching. They perceive online learning as flexible and self-paced, allowing them to study anytime and anywhere, and enabling better management of their learning progress. As shown in Table 2.

Table 2 Preferred Learning Mode

Options	Number	Percentage
Blended mode (online and offline)	398	70.07%

Options	Number	Percentage
Offline mode	125	22.01%
Online mode	45	7.92%

Regarding students' ability to independently complete online learning tasks, the majority of students (96.3%) demonstrate a certain level of self-control. They are able to complete the assigned online learning tasks independently for the most part. This indicates a high level of autonomy and effective management of their learning time and plans. However, there is a small portion of students (3.70%) who reported having average self-control and lack awareness of online and independent learning. These students may require additional support and guidance to enhance their self-discipline and autonomous learning abilities.

Table 3. Can you independently complete online learning tasks?

Options	Number	Percentage
Able to	269	47.36%
Somewhat able to	278	48.94%
Not able at all	21	3.70%

In a survey on the assistance needed by students, the results reveal a variety of learning demands, as shown in Table 4. Firstly, 67.95% of students expressed their desire to increase the duration of online practical tasks. This indicates their recognition of the importance of practical assignments in reinforcing learned knowledge and enhancing practical skills. Secondly, 58.05% of students wished for an expansion of course resources on the online learning platform. This reflects their eagerness to access a more diverse, extensive, and high-quality range of online resources to adapt to the technological challenges brought about by rapid advancements in information technology. Additionally, 46.77% of students hoped for the integration of teaching content with the National Computer Rank Examination (NCRE) topics, enabling them to better prepare for and perform well in this exam. Furthermore, 41.70% of students desired collaborative learning opportunities, which would provide them with more chances for communication and mutual support with peers, promoting their learning growth, teamwork, and communication skills.

Table 4 In which areas do you still need assistance? (Multiple selections)

Options	Number	Percentage
Increasing the duration of online practical tasks	831	67.95%
Expanding online learning resources	710	58.05%
Integrating teaching content with the National Computer Rank Examination (NCRE)	572	46.77%
Promote collaborative learning	510	41.70%

The results of the survey on the difficulties encountered by students in the learning process indicate that 67.46% of students find Excel spreadsheet operations to be the most challenging, particularly the application of functions. They may face difficulties in understanding and applying formulas and functions, as well as learning obstacles in data processing and analysis skills. Additionally, 11.28%, 8.83%, 7.85%, and 1.88% of students respectively have

difficulties in Windows system applications, network operations, Word document processing, and PowerPoint presentation creation, as shown in Table 5.

Table 5 Difficulties Encountered in the Learning Process

Options	Number	Percentage
Windows system applications	138	11.28%
Word document processing	96	7.85%
Excel spreadsheet	825	67.46%
PowerPoint presentations	23	1.88%
Network applications	108	8.83%

Through multiple surveys and in consideration of actual teaching situations, we have realized that there are differences in students' knowledge foundation and practical abilities. Students have diverse needs in terms of learning modes, learning resources, and instructional guidance. Firstly, students generally express dissatisfaction with the limitations of traditional offline teaching methods and desire more flexible, practical, and up-to-date instructional approaches. Secondly, personalized learning has become an unignored trend because each student has a unique learning style and interests, and traditional one-size-fits-all teaching cannot meet their personalized learning needs. Additionally, we have also discovered an increasingly urgent demand from students for practical skills and their desire to collaborate with peers in solving real-world problems. These findings will guide us in innovating and optimizing educational models to meet the ever-changing learning needs of students, promote their comprehensive development, and enable them to adapt to future societal challenges.

3 Teaching Reform and Practice

The foundational course in information technology falls under the "tool utilization" category in engineering education [4]. Traditional teaching methods like lectures, demonstrations, and exercises no longer meet the requirements of modern information technology courses. In response to survey feedback, we have created a teaching environment that combines digital tools and online learning platforms, integrating cloud and reality[5]. With the core concept of "integration of Teaching, learning and Doing," we have implemented task-driven blended teaching reforms and practices. This involves modularizing teaching content, digitizing teaching methods, and dividing knowledge points into different modules. Each module is guided by specific tasks to encourage active exploration and practical application by students. Our focus is on enhancing students' self-directed learning abilities through 4A-style (Anyone, Anytime, Anywhere, Anyway) self-directed learning, while providing learning support and guidance.

3.1 Tools and Means

Combining the online learning platform based on the SPOC (Small Private Online Course) model, the MOOC (Massive Open Online Course) model of Cisco Networking Academy, and digital teaching tools like "Rain Classroom," this approach utilizes various teaching tools to leverage their respective advantages. It overcomes the limitations of traditional teaching

methods that are singular and one-sided, while also addressing the challenges of managing and promoting interaction in large-scale open MOOCs[6-8].

Firstly, the 5Y online learning platform in the SPOC model provides personalized and customized task experiences. Students can selectively engage in task-based training according to their needs and interests, fulfilling personalized learning requirements and enhancing practical skills. It achieves an organic integration of "online learning, task practice, instant demonstration, and intelligent assessment."

Secondly, the MOOC model of Cisco Networking Academy offers students access to a massive range of open educational resources. Students can access high-quality course materials globally, expanding their learning horizons and facilitating cross-cultural communication and collaboration.

Additionally, digital teaching tools like "Rain Classroom" enhance interactivity and feedback mechanisms during the learning process. Through features such as online discussions and evaluations, students can actively interact with teachers and peers, collaborating in problem-solving and exploring issues together.

3.2 Objectives and Positioning

This course is a mandatory foundational course for students in general higher education institutions, offered in the first year of university and does not require any prerequisite courses. It can be followed by various specialized or core courses. Based on the talent requirements of the intelligent manufacturing and information industries in the Guangdong-Hong Kong-Macao Greater Bay Area, this course focuses on cultivating students' discipline literacy in information literacy foundation, information awareness, computational thinking, digital innovation and development, and information social responsibility. The objectives of this course are as follows:

Knowledge objectives: Understand the development history of computers, computer hardware and software systems, information encoding, and other fundamental knowledge and principles. Master commonly used software tools such as operating systems, Office 2016, WPS, and digital office technologies. Gain knowledge of emerging information technologies such as artificial intelligence, big data, cloud computing, new media, and blockchain.

Skills objectives: Improve the ability to acquire, analyze, process, and apply information. Possess the skills to use Word for document editing, Excel for spreadsheet processing, and PowerPoint for presentation creation. Develop proficiency in using operating systems, network information services, and computer security protection.

Attitude objectives: Cultivate good habits of self-directed learning, strong communication and expression skills, teamwork spirit, and possess preliminary information awareness and computational thinking.

3.3 Modules and Content

Following the principles of teaching and students' cognitive growth, the course content has been restructured to form three major teaching modules for advancing capabilities in "Fundamentals of Information Technology, Digital Office Applications, and Exploration of

New Technologies." These modules cover 132 knowledge points and over 500 micro-videos, creating a hierarchical and progressive instructional content. The course consists of 44 class hours, and the specific content is designed as follows:

Fundamentals of Information Technology module(12 class hours): This module breaks down three cases related to operating systems, network applications, and information security into six tasks, covering topics such as computer hardware and software fundamentals, network connectivity and configuration, information security strategies, and protection.

Digital Office Applications module(26 class hours): This module breaks down six cases, including creating event proposals, managing salary sheets, and introducing my hometown etc, into twelve tasks. Students will learn how to use mainstream office software like Microsoft Office and WPS.

Exploration of New Technologies module(6 class hours): This module includes three tasks: experiencing face detection and facial expression recognition technology, creating a WeChat mini-program for a company, and collecting and analyzing data from JD.com. It aims to provide an understanding of emerging technologies such as artificial intelligence and big data.

Taking the Digital Office Applications module as an example, the Excel knowledge points shown in Table 6 are explored and applied more extensively based on the "salary sheet management" task after the reform. This involves delving deeper into Excel core functions and advanced operation techniques to enhance students' practical skills and problem-solving abilities. The reformed course has achieved significant improvements in terms of depth, breadth, and practicality, making the course content more aligned with actual work requirements and helping students adapt to future career development challenges.

Table 6 Key Teaching Points for Excel Functions and Database Section After Reform

Category	Function	Key Teaching Points
Functions	Mathematical functions	ABS, INT, ROUND, TRUNC, RAND
	Statistical functions	SUM, SUMIF, AVERAGE, COUNT, COUNTIF, COUNTA, MAX, MIN, RANK
	Date functions	DATE, DAY, MONTH, YEAR, NOW, TODAY, TIME
	Conditional functions	IF, AND, OR
	Financial functions	PMT, PV, FV
	Frequency distribution function:	FREQUENCY
	Database statistical functions	DCOUNT, DCOUNTA, DMAX, DMIN, DSUM, DAVERAGE
	Selection function	CHOOSE
	Lookup function	VLOOKUP
Database Operations	Sorting and filtering	Conditional sorting, data validity, auto-filtering, advanced filtering
	Data analysis and reporting	PivotTables, Pivot Charts
	Hierarchical display	Categorization, summarization, statistics

3.4 Organization and Implementation

Centered around students and following constructivist educational ideas, the approach introduces new knowledge points based on a spiral progression of tasks. By incorporating appropriate cognitive conflicts across varying difficulty levels, it stimulates students' desire for knowledge and enables them to continuously surpass their immediate developmental zones through the formation of new knowledge extensions and knowledge transfer, thereby enhancing their skill levels.

The teaching process is divided into three stages: pre-class independent exploration, in-class collaborative tasks, and post-class extension and improvement. It is organized and implemented as an "integration of teaching and practice" through six steps: "pre-class preview, task analysis, explanation of difficulties, task practice, presentation and feedback, post-class extension." Teaching methods such as task-driven approach, situational teaching, flipped classroom, and role-playing experiences are flexibly applied. Cooperative groups are scientifically formed to create a learning community where practical tasks are collaboratively completed, motivating students' learning enthusiasm and increasing classroom engagement.

Independent exploration before class : The teacher assigns learning tasks and provides learning resources. Students engage in independent online previewing, training, and testing. Learning behavior data is collected and analyzed to optimize in-class teaching strategies based on individual learning situations.

Task implementation during class: Using tasks as the main thread, teaching unfolds in four stages: "task analysis, overcoming difficulties, task practice, presentation and feedback," simulated in real-world application scenarios. Through group cooperation, teacher-student interaction, and peer-to-peer interaction, students' comprehensive abilities, including expression and communication, teamwork, inquiry and innovation, and transfer and application, are cultivated.

Extension and improvement after class: Based on students' performance during class, the teacher designs differentiated extension and training tasks to strengthen personalized development. Students engage in discussions and interactions in the course platform's discussion area, while the teacher provides clarification, consolidates learning outcomes, and enhances their application.

3.5 Assessment and Evaluation

Information Technology Fundamentals is an applied technology course. In the past, we primarily assessed students' theoretical knowledge learning outcomes through paper-based exams, which couldn't fully reflect their practical operational abilities. The reformed course assessment and evaluation mechanism are shown in Table 7.

Table 7 Assessment Mechanism

Assessment method	Major	Percentage	Implementation method
Formative assessment (40%)	Non-Art, Non-Sports Majors	Completion rate of online knowledge-based tests (50%)	5Y Online Learning Platform
		Cisco networking course	Cisco Networking

		assignments (50%)	Academy (CAN)
	Art, Sports Majors	Completion rate of online knowledge-based tests (100%)	5Y Online Learning Platform
Final assessment (60%)	All majors	Theoretical knowledge assessment (20%), Practical skills assessment (80%)	5Y Online Learning Platform

During the process assessment stage, the focus is on students' self-learning abilities and practical skills using information technology tools. For non-art and non-sports majors, in addition to completing knowledge tests on the 5Y online learning platform, they are also required to independently complete the Cisco Networking Academy's IT Essentials: PC Hardware and Software online course.

In the final assessment stage, a third-party examination and certification organization, the "Guangdong Provincial Higher Education Examination Management Center," is introduced. The final assessment is conducted using the question bank of the National Higher Education Computer Level Examination (CCT, Common Computer Test). Students who achieve a passing score (60 or above) can apply for a CCT Level 1 certificate, while those who excel (80 or above) can apply for a CCT Excellence certificate.

4 Application

Taking Zhuhai College of Technology as an example, a task-driven teaching reform based on "modularization + digitalization" has been implemented since 2018. The curriculum content has been divided into three modules, through the application of digital tools and learning platforms, students can choose learning paths more flexibly and gain personalized learning experiences. By creating linkages between progressive tasks and establishing neighboring development zones, students are encouraged to explore proactively and collaborate in problem-solving, enhancing their creativity and teamwork abilities.

The teaching team has been continuously reforming and innovating in the field of digital education. In 2018, the digital office application module upgraded the software from Office 2003 to Office 2010. Additionally, in non-art and physical education majors, an online self-study course called "IT Essentials: PC Hardware and Software," provided by Cisco Networking Academy, was introduced. It aims to give students the opportunity to engage with the latest internet technologies and enhance their ability for independent learning through online learning formats. In 2021, the digital office application module was upgraded again, this time from Office 2010 to Office 2016, with the goal of introducing the latest office software and tools to ensure students stay synchronized with industry standards. In 2022, the WPS office software module was added, offering personalized software choices to meet the diverse needs of students in different tasks and projects, cultivating their adaptability and flexibility.

Table 8 Comprehensive Test Results for the 2018-2022 Cohorts on the 5Y Platform

Grade	Teaching Mode	Software	Number	Average Score	Pass Rate	Standard Deviation
2018	Blended Mode	Office2010	6763	75.38	86.63%	14.95
2019	Blended Mode	Office2010	6183	74.38	85.57%	15.03
2020	Primarily Online Teaching	Office2010	6047	66.48	73.52%	15.52
2021	Blended Mode	Office2016	5711	71.26	85.17%	12.82
2022	Blended Mode	Office2016+WPS	1129	71.61	84.94%	12.80

Note: Due to the widespread outbreak of COVID-19, we had a limited sample size of only 1129 individuals for the class of 2022.

According to the online comprehensive assessment data in the past five years following the educational reforms listed in Table 8, we have made observations and conclusions from various perspectives such as teaching modes, assessment software, and the impact of the pandemic.

Teaching modes and performance: In 2020, due to the impact of COVID-19, schools implemented mainly online teaching measures to control social distancing. Some students reported average self-control abilities and a lack of awareness towards online and autonomous learning (see Table 3) due to the absence of face-to-face interaction and practical opportunities. This may have had a negative impact on student performance. Therefore, the average scores and pass rates in 2020 were relatively low.

Office software and performance: As students transitioned from using Office 2010 to Office 2016 and added the WPS office software module in 2022, these improvements provided students with more advanced and comprehensive tools, which helped enhance their practical skills and creativity. However, the increase in the depth and breadth of learning has had a certain impact on student performance.

To evaluate the effectiveness of the educational reforms, we conducted a questionnaire survey. The survey results regarding the question "Has this course helped you improve your computer application skills?" showed that 88.47% of students found this course to be significantly helpful in improving their computer application skills, 10.71% of students considered the impact of this course on their computer application skills to be average, and an additional 0.82% of students felt that this course provided little assistance, as shown in Table 9.

Table 9 Has this course helped you improve your computer application skills?

Options	Number	Percentage
Very helpful	605	49.47%
Helpful	477	39%
Average	131	10.71%
Not very helpful	10	0.82%

The survey results regarding the question "Are you satisfied with the courses on the online learning platform?" showed that 85.20% of students expressed a positive evaluation of the online courses, stating that the content was well-structured and provided highly targeted instructional videos. Another 13.82% of students considered the effectiveness of the online courses to be average and expressed a desire for more personalized learning guidance. Furthermore, 0.98% of students held a negative opinion of the online courses, perceiving them to have limited helpfulness. This is illustrated in Table 10.

Table 10 Satisfaction with online courses

Options	Number	Percentage
Very good, the content is reasonable and provides highly targeted instructional videos	1042	85.20%
Average, hoping for more personalized learning guidance	169	13.82%
Not good, the courses are of limited help	12	0.98%

The survey results regarding satisfaction with the Cisco Networking Academy (CAN) course indicate that 60.18% of students are highly satisfied with the course, finding it greatly beneficial for improving their computer skills. Additionally, 36.71% of students consider the course to be average, as it expands their knowledge, but the difficulty of the questions is relatively high. Furthermore, 3.11% of students believe the course is not good because it lacks practical exercises and offers little assistance in skill improvement, as shown in Table 11.

Table 11 Satisfaction with courses in Cisco Networking Academy (CAN)

Options	Number	Percentage
Highly satisfied, greatly helpful for improving computer skills	736	60.18%
Average, expands knowledge but presents challenging questions	449	36.71%
Not good, lacks practical exercises and offers little assistance in skill improvement	38	3.11%

According to the survey results on "Do you approve of blended learning combining online and offline activities?", 63.56% of students expressed agreement and anticipation for adopting a blended learning mode in their study activities. Additionally, 31.87% of students moderately approved of this mode. However, 4.58% of students indicated that they still haven't fully adapted to blended learning and feel discomfort with this mode, as shown in Table 12.

Table 12 Acceptance of Blended Learning Mode

Options	Number	Percentage
Agree and anticipate	361	63.56%
Moderately agree	181	31.87%
Not fully adapted	26	4.58%

In summary, the majority of students acknowledge the role of educational reforms in improving computer application skills and provide positive feedback on the course content and targeted instructional videos on online learning platforms. However, some students express dissatisfaction with specific courses, such as the difficulty level or the lack of practical exercises in Cisco Networking Academy (CAN). Furthermore, while students generally support educational reforms, a few students still require more time to adapt to this learning mode.

5 Conclusions

To address the ever-changing learning situations, personalized learning needs of students, rapid development of information technology, as well as the reduction of in-person teaching hours and deepening of course content, we actively engage in educational reforms and practices to create a self-directed, diverse, and collaborative learning environment. On one hand, we modularize the teaching content, incorporate advanced training tasks, and enhance the depth of instruction. Simultaneously, we introduce supplementary content on emerging information technologies to guide students in broadening their knowledge and developing comprehensive thinking and problem-solving abilities. On the other hand, we leverage digital teaching methods to provide online learning platforms and resources, supporting the demands for online and blended learning. This flexible teaching approach not only improves students' learning outcomes and enhances their self-directed learning abilities but also cultivates their information retrieval and technological application skills. To stimulate students' motivation for learning and enhance their practical abilities, We prioritize task-driven teaching. By setting challenging and practical tasks, students can engage in collaborative inquiry-based learning in the classroom, thereby improving their problem-solving and teamwork skills.

Educational reforms have achieved some accomplishments amidst challenges and opportunities. However, through statistical analysis, we found that the average scores for the 2022 cohort in the majors of Music and Dance, Fine Arts and Design, and Sports Science were 54.36, 61.13, and 62.56, respectively, indicating a significant gap compared to other majors. Improving the learning outcomes of academically weak students remains a direction we continue to strive towards.

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