Path Analysis of the Influence of Informatization Teaching on the Learning Effect and Experience
--Exploration research based on business courses teaching experiment

Yao Lu[1*]

[1] PhD, School of Business, Sichuan Normal University, Chengdu, 610000, China

ARTICLE INFO

Keywords:
Informatization teaching, Learning effects, Learning Experience, Grounded Theory, Qualitative study

ABSTRACT

In order to clarify the specific impact path of information technology on student learning interest and learning results, this study utilized informatization teaching tools such as MOOCs, IT-aided quizzes, video case analysis, etc. in a 3-month teaching experiment. Based on the grounded theory, this paper proposes an SRIO model to explain the influence of information technology on student learning effect and learning experience on the basis of student interviews. Meanwhile, this study further presents four positive paths to describe how the teaching content and form stimulate students and further influence their learning experience and results. The findings might have a marginal contribution to the research and practice of informatization teaching.

1.Introduction

With the development of technology, Internet Plus Education has become a hot topic in China, emphasizing the importance of information technology utilization in education.

At present, various digital teaching tools or informatization teaching tools (ITTs) have been used in Chinese colleges and universities. The most widely used functions include online courses, teaching-support tools, data-sharing platforms, etc. Among them, online courses attract the most attention from both academic and practical fields. During the pandemic period, a total of 1,454 colleges and universities across the country carried out online teaching, 1.03 million teachers offered 1.07 million courses online, totaling 12.26 million courses, and a total of 17.75 million college students participated in online learning [1]. Colleges and universities across the country can all get access to national excellent courses through the MOOC platform, realizing the wide-ranging resource sharing of course content and excellent teachers [2]. The integration of online and offline learning has also improved the flexibility of students' learning. At the same time, however, some students report difficulties in online learning and poor learning efficiency[3]. Therefore, online courses might not be considered as the main form of information-based teaching in colleges and universities. One of the main values of digital education tools is represented in the assistance of classroom teaching, and the education quality can be improved through effective combination between digital tools and offline education.

Secondly, teaching-support tools such as UMU and Rain Classroom can assist teachers in classroom teaching through functions such as sign-in, quiz, voting, discussion, and teaching materials sharing, which is considered to exert a certain promotion effect on learning. Specifically, the sharing function and feedback function generated by the above tools are the key functions of information technology [4], which boost classroom interaction and indirectly improve the learning effects of higher education. Specifically, the functions of sharing, such as teaching slides and supplementary course materials, play a role in supporting the interaction between students and content, while feedback functions such as bullet screen and discussion take effect more in supporting the interaction between students, teachers, and their classm-

*Corresponding author

E-mail addresses:yao.l@sicnu.edu.cn (Yao Lu)

Received May 21,2025; Received in revised form May 23, 2025; Accepted May 28, 2025

ates [5]. However, how and in what path exactly these functions affect students' learning needs to be further clarified.To sum up, although a large number of information technology have been used in the college and university education at present, how to effectively integrate these various digial teaching tools remains an issue[6]. While enriching the practical teaching methods, the underlying scientific reason are also worth exploring.

2 Literature review

In the 20th century, numerous psychologists carried out a lot of research on learning theory. Among them, psychologists represented by Carl Rogers put forward humanistic student-centred learning theory, emphasizing that students play the main role in the learning process. Teachers, as learning facilitators, should provide the conditions that lead to meaningful and significant self-directed learning [7]. For stimulating students' learning motivation, aside from the traditional task-based motivation, learning interest, as the inherent tendency of students in the learning process, is considered an important factor to improve the learning process and learning quality [8]. Generally, the extent of students' learning interest is influenced by many factors, such as one ' s intrinsic appeal of the subject, emotional experience in the learning process, and perceived course value [9]. Among them, from the perspective of constructivism learning theory, knowledge is constructed based on experiences, and students realize the understanding and absorption of knowledge based on personal experience and interactive processes [10]. Through the empirical research of mathematics, science, and engineering technology education, it is also found that college students' learning interest has a significant positive impact on their learning achievements, that is, academic achievements [9, 11, 12]. Concerning students' learning interest, based on the previous research of Suzanne Hidi and other scholars, it can be further divided into students' personal interest and situational interest [13]. Among them, personal interest mainly refers to the long-lasting preference for a certain topic or field that is related to individual value orientation, closely related to students' internal activities and motivation. Situational interest refers to the short-term value tendency related to the situation in which students are located and stimulated by the environment. Although some scholars have built the theory of interest development stage, believing that situational interest can be transformed into personal interest [8], compared with personal interest, situational interest is easier to be aroused and then used in teaching activities [13], so its role is more direct from the perspective of improving the course teaching effect. In this specific environment of the classroom, whether students' situational interest is aroused can be observed through their behaviours. For example, burned-out, low-interest students are prone to avoidance behaviours [14], and their enthusiasm for participating in classroom learning is low. The interest in learning a specific course can direct the individual's attention to the object where one is willing to approach and maintain the individual's perception and specific participation in the course learning process [15]. In practice, it is found that the use of digital teaching aids such as digital textbooks can enhance students' interest in participating in this learning activity in the classroom [16]. The use of the internet and information technology is considered an effective way to improve students' self-efficacy and willingness to learn [17]. However, concerning stimulating students' learning interest and improving learning effect, the existing research is more focused on the traditional topics, such as creating a relaxed learning atmosphere, integrating questions into the teaching process, and providing timely counselling to students [18]. Although informatization teaching related studies on electronic textbooks and classroom participation were conducted, there are still a large number of informatized teaching tools to be further explored, and how these tools work needs to be further clarified.

3 Research design

This study firstly conducted a semester-long experimental course instruction incorporating a variety of ITTs, followed by structured interviews with students at the end of the semester. Students' classroom and final test performance are observed based on outcomes generated from these ITTs. Based on the interview transcripts, a grounded analysis was conducted using NVivo12 to form a theoretical model that presents how informatization teaching affects learning behaviour and learning results.

281 undergraduates majoring in financial management at SICUN in China participated in this research in 2019. We conducted a 3.5-month experimental teaching with ITTs. The course of Enterprise Internal Control was taught, and the core teaching purpose of the course is to help students understand the basic theoretical knowledge of internal control and its application in enterprise management practice. Since the knowledge in this course is not as well structured as in the natural sciences, and it is difficult to cover all enterprise applications in the classroom, both knowledge acquisition and transfer become crucial. Therefore, the traditional passive teaching is no longer suitable under this situation [19]. In order to improve instruction quality and find out the influence of informatization teaching, this study applies various ITTs such as "Xuetang Online" (a Chinese massive open online course platform), "Rain Classroom" (teaching management platform), video clips of film and television dramas, etc. to the instruction process, as shown in Table 1.

Table 1: Content and Purpose in the Informatization Teaching Experiment

Informatization Teaching Tools	Notes	Purpose/Function
MOOCs	Xuetang Online, a Chinese massive open online course platform	Provide learning materials for online pre-learning
Rain classroom	A Chinese teaching process management platform	Manage the classroom teaching and generate students ' multi-stage course performance data
Video case	Video clips from TVdramas and students -made videos	Case analysis materials
Microsoft Office	Powerpoint	Support students ' final presentation for the internal control consulting s imulation project
Discussion monitoring video	Record of students ' after-class task disc ussion	Support students ' task management and stimul ate concentration

After the experimental instruction applying ITTs, based on one-on-one structural interviews with students, grounded theory is adopted to conduct learning process analysis and preliminary theoretical exploration. Using NVivo12, the influence of various teaching tools on students is explored through open coding, axial coding, and selective coding of the original materials, and in the process of data analysis, constant comparison and additional interviews testing were conducted to ensure theory saturation [20].

4 Results

In the selection of interviewees, in order to obtain diversified student feedback, we divided all students into four groups according to the students' final grades, including the top 25%, 50%, 75%, and the bottom 25% group. Then we conducted a proportionate stratified random sampling accordingly to ensure that students in each group were selected into the interviewee pool. In addition, a slight adjustment of the interview list was made to focus on the analysis of problem students and to test the preliminary model. At the same time, in order to find out the reasons for the existence of abnormal data in quantitative analysis, the abnormal data is also included in the interviewees. Finally, 17 students were selected, including 3 students from the top 25% group, 4 students from 25% to 50%, 4 students from 50% to 75% , and 6 students from the bottom 25%. In this study, 4/5 of the interview records (13 copies) were randomly selected for coding and model construction, and the remaining 4 copies (1 copy in each group) were reserved as saturation test data [20].

In the open coding stage, this study firstly labels and conceptualizes the information in the interview records and then further categorizes it based on its connotative relevance. After passing the saturation data test, 31 initial categories were finally formed based on the original data. During the axis coding stage, we mainly register every initial category, analyze their connotation, and build clusters, and then form the final categories and subcategories to capture the students' learning experience features, as shown in Table 2.

Table 2 Example of coding results

Category	Sub-category	Initial category	Primitive statement (initial concept examples)
A Instructional Activity Design	A1 Content	Demonstrative	N5: We can see the specific scenario where to use this knowledge. This kind of video can be used a little more often. It is very interesting. (Scenario) N10: It can enable us to clearly understand internal control and related operations and avoid fraud through internal control. (Intuitive understanding)
		Relevant	N3: (Video cases) can reflect some knowledge of internal control. (Reaction internal control knowledge) N1: The video may have other (irrelevant) information that affects understanding. (Noise)
	A2 Form	Timeliness	N4: It is better to practice while learning during the instruction process. (Instant Practice)
		Instrumentality	N4: The quizzes and the review tests are good, since we can also use them for our final test preparation. (Review tool) N5: Before learning a specific knowledge, it can make us have a simple understanding, arouse interest, and make us well integrated into learning this knowledge. (Paving the way for follow-up learning)
B Student Behavior	B1 Positive Behavior	Focus	N2: We are all quite foucsed. (High attention)
		Explore knowledge	N14: Looking for related knowledge by myself deepened my understanding again. (Actively seek knowledge)
	B2 Negative Behavior	Perfunctoriness	N6: Most students don't watch the MOOC video carefully. (Don't watch carefully) N15: It may be better to do the case in class. After-class discussion might require more. The first two times were okay, and there was a discussion, but later on it became perfunctory, and (we did it just for finishing) the task. (Perfunctory)
		Not paying attention	N2: If the case analysis is done after class, people don't pay much attention to it. (Low attention)
C Influence Process	C1 Stimulation	Supervise learning	N1: Quizzes can urge us to learn. (Urge learning)
		Stimulate review	N7: Although I don't feel good (being tested) in the class and have to review notes and the textbook, it's still very useful in the end. (Stimulating review)
	C2 Catalysis	Enable situational understanding	N15: I can see what internal control elements are in the video. (Promote understanding)
		Enable knowledge internalization	N8: The video feels quite useful because it is easier to understand and remember than the contents in the book. (Help remember)
D Psychological Perception	D1 Positive Feelings	Sense of gain	N1: (Internal control consulting simulation project) is useful, and targeted information collection will be done according to knowledge, which is beneficial to the application of knowledge. (Useful)
		Impressive	N4: Because everyone watched (video cases) and discussed together in class, we were deeply impressed. (Impressive)
	D2 Negative Feelings	Boring	N6: It will be boring to read cases in text all the time. (Boring)
		Low efficiency	N9: If recording a (group discussion) video, it is not more efficient than doing it by oneself. (Low learning efficiency)

Based on these categories, a model of "SRIO" was abstracted and proposed in this research to explore the influences of ITTs on students' learning perception and experience and the influence process. SRIO stands for stimulus-response-impact-outcome. In the selective coding stage, four positive paths are extracted based on this model (as shown in Table 3). The research shows that by making the learning materials more interesting, relevant to knowledge, and demonstrative , it can promote students' attention level and stimulate students' independent knowledge inquiry behaviour so as to achieve the role of knowledge understanding and internalization and further enhance students' sense of knowledge acquisition.

Table 3 Selective coding results: influence pathways

SRIO Pathway	Explanation
Relevance-> Explore knowledge-> Enable knowledge internalize-> Sense of gain	The contents presented by ITTs, which are highly related to the target knowledge, stimulate students to carry out independent knowledge exploration, help them understand knowledge better, and stimulate a sense of knowledge acquisition.
Interestingness-> Attention/Explore knowledge-> Enable knowledge internalization-> Sense of gain/deep impression	The contents presented by ITTs, which are interesting, or the tool of which the form is interesting to students, attract their attention, enable them to actively try to explore the concept and the relationship between related knowledge, help them better understand the target knowledge, and stimulate a sense of knowledge acquisition and deeper impression on the target knowledge.
Demonstrative-> Explore Knowledge-> Enable knowledge internalization/Enable situational understanding-> Sense of gain	The ITTs can further enhance the demonstrativeness and comprehensibility of the target knowledge, which enables students to better explore the knowledge by reducing students ' cognitive load. As a result, students might a chieve better knowledge internalization and a sense of gain.
Stress-> Explore knowledge-> Stimulate review/help internalize-> Sense of gain/ deep impression	The psychological pressure caused by ITTs can drive students to review notes, form a deeper impression of knowledge, and produce a sense of gain.

In this study, the remaining 1/5 (4) interview records were used to carry out a theoretical saturation test. As a result, we found that the concept of categories and its relationship have already been shown in the above-mentioned model. Therefore, it can be considered that the influence model of informatization teaching design on students' learning behaviour and effect (as shown in Figure 1) is theoretically saturated.

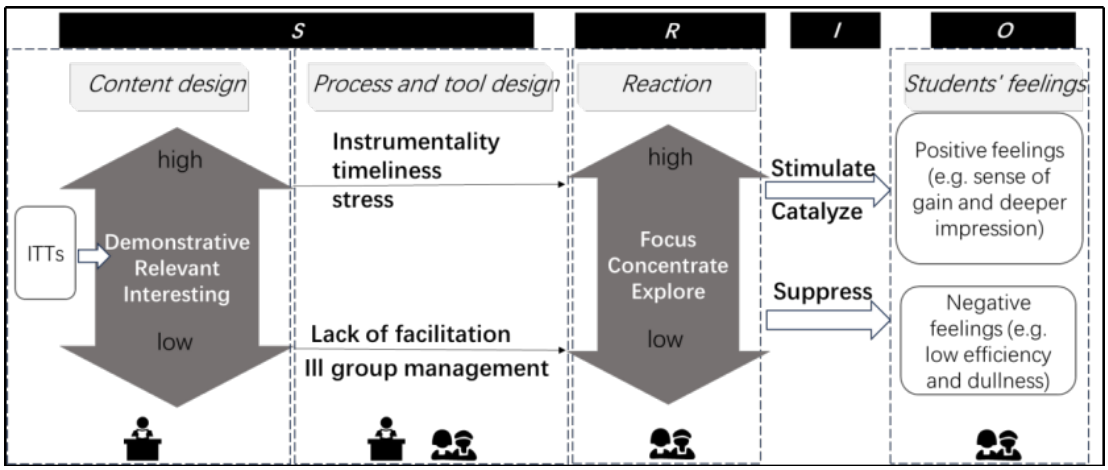

Fig. 1 The SRIO model: ITTs based teaching ' s influence on students

From the experiment, we found that the influence of ITTs mainly comes from two main parts, which include the content ITTs carry and the form of ITTs. Meanwhile, the instruction process matters as well. Improving the demonstrativeness, relevance, and interestingness of teaching content might have positive impacts on learning. At the same time, in the teaching process, students should be given moderate pressure and timely review, while ITTs should be able to enable these purposes. The whole learning process should be supervised, and students ' responses can be a g ood indicator. For instance, if students show high classroom attention, such as exhibiting concentration and active explo ration during case analysis, it indicates that the teaching stimulation is positive and effective, which implies a better lear ning experience and outcome. Therefore, if no corresponding positive performance is observed, it indicates that the teac hing content might be obscure and poorly structured, and corrective measures should be taken actively during the instr uction.

5 Discussion

This study finds that the content, the form, and the process management of ITTs have obvious influence on students ' learning experience. For instance, with ITTs, it is possible to conduct time-limited quizzes. On the one hand, it brings slight pressure to students and stimulates them to focus on learning. On the other hand, by using ITTs, it is feasible to identify students ' misunderstandings and provide timely feedback to them. These are all related to their knowledge int ernalization. For video case analysis, the interesting and demonstrative contents are found to have an impact on student s' learning, but access to replay the video should be given to avoid the possibility that a small number of students' inabili ty to keep up with the pace. In addition, learning process management based on the figures from these ITTs can also help to improve the instruction quality.

From the perspective of humanistic learning theory and learning interest theory, different ITTs have different specific influence paths and degrees of influence on students. The ITTs that enable classroom quizzes mainly arouse students' situational interest by the form of ITTs. Specifically, the pressure of time-limited completion and the instrumentality of after-class review all make students respond positively to this kind of teaching method. At the same time, the ITTs, such as video, role-playing, and other elements, arouse students' situational interest by the contents that relate to students' after-school hobbies and then stimulate their positive reactions. The application of various ITTs in the instruction process can meet the needs of students with different situational preferences, but any method requires teachers to take active and timely process observation and intervention.

The analysis is conducted on only one semester ' s data. Although the saturation test has been conducted, the extens ionality of the research conclusions needs to be further tested. In the future, more ITTs related experiments can be cond ucted in different courses to testify to the robustness of this model.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have app- eared to influence the work reported in this paper.

Acknowledgments

Supported by Sichuan Normal University's school-level teaching reform project (project number: 20230064XKC).

References

[1] Chinese Ministry of Education. Introduce the situation of online education in universities, primary and secondary schools during the epidemic and considerations for the next work [Z]. 2020. http://www.moe.gov.cn/fbh/live/2020/ 51987/.
[2] Zhang, B. W. (2023). The connotation, form and representation of college curriculum spillover effect under the background of digital transformation [J]. Jiangsu Higher Education, 02, 80-85.
[3] Wen, W., Zhou L., & Ma Z. X. (2023). Analysis of college students' online courses under the background of normalization of online education [J]. Education Development Research, 43 (05), 28-36.
[4] Wu, Y. C. J., Pan, C. I., & Yuan, C. H. (2017). Attitudes towards the use of information and communication technology in management education [J]. Behaviour & Information Technology, 36 (3), 243-254.
[5] Yan, M. L., Chen, L. P., & Guo, J. (2022). How key functions of information technology affect multi-level learning effects-a mixed study based on student questionnaires and interviews [J]. Jiangsu Higher Education, 06, 102-109.

[6] Li, S. Y., & Yang, C. Z. (2008). Information-based teaching strategies focusing on learning styles [J]. China Audio-visual Education, 09, 20-22.
[7] Lei, G. (2010). New enlightenment of humanistic learning theory to educational technology [J]. China Audio-visual Education, 06, 30-33.
[8] Hu, J. M., & Zhao, L. Z. (2021). Development stages, influencing factors and stimulating paths of learning interest [J]. Courses. Textbooks. Teaching Methods, 41 (11), 78-85.
[9] Li, P., & Cao, L. H. (2021). Research on the relationship between college students' "learning interest", "self-efficacy", " learning anxiety" and "learning motivation" in advanced mathematics [J]. Journal of Mathematics Education, 30 (04), 97-102.
[10] Ertmer, A. P., Newby, T. J., & Sheng, Q. L. (2004). Behaviorism, cognitivism and constructivism (Part 2)--Comparing their key characteristics from the perspective of instructional design [J]. Audiovisual Education Research, 04, 27-31.
[11] Xing, B. B., Liu, C., Zhao, L. L., & Fan, L. X. (2022). The impact of blended experimental teaching in colleges and universities on students' learning effectiveness and learning experience-taking the "Basic Chemistry" course as an example [J]. Modern Educational Technology, 32 (02), 99-108.
[12] Pu, X. S., & Kang, J. C. (2021). Academic performance, STEM interest and 21st century skills-analysis based on mediation effect model [J]. Open Education Research, 27 (04): 71-84.
[13] Schraw, G., & Lehman, S. (2001). Situational Interest: A Review of the Literature and Directions for Future Research [J]. Educational Psychology Review, 13: 23-52.
[14] Wang. M. C., & Zhang, L. X. (2011). Performance and intervention strategies of college students' learning burnout [J]. Education Exploration, 6: 143-144.
[15] Ma, H. X., Nie, S. Y., & Su, S. J. (2010). Academic emotions of college students in examination situations [J]. Psychological and Behavioral Research, 8 (03): 201-207 +222.
[16] Zhuang, S. Y., Geng, J., & Shang, J. J. (2013). A case study on the implementation of tablet-based electronic textbooks in English classroom teaching in Hong Kong [J]. Modern Distance Education Research, 2: 92-99.
[17] Wang, B. B., Cheng, Y. Q., Wang, Y., Wang, D. D., & Li, Y. M. (2020) Research on the application of cloud teaching in the digital experimental class of chemistry normal students [J]. Chemistry Education (Chinese and English), 41 (04): 60-68.
[18] Zhao, C. X. (2023). Guiding analysis of interest orientation in mathematics teaching [J]. Chinese Journal of Education , S1: 89-90 +93.
[19] Mo, L., & Hu, G. Q. (2014). Exploration of "Constructivist" Internal Control Course Teaching-Based on the Practical Perspective of Applied Undergraduate Teaching [J]. Accounting Monthly, 24: 120-123.
[20] Sun, Y. W., & Zhang, S. (2018). Research on the driving mechanism of social innovation in high-tech enterprises based on grounded theory [J]. Business Research, 09: 129-134.
[21] Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential exploratory design: From theory to practice. Field methods, 18 (1).