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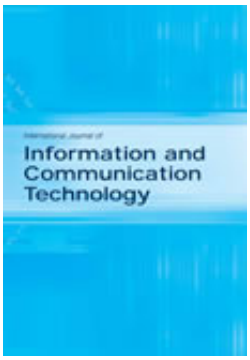

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Abstract: Cultivating innovative talents with learning capability, research awareness, and study capacity is the current direction of teaching reform in college English major, which is also the ultimate goal of English major education. Guided by the 4C four-component instructional comprehensive task design model developed by Professor Jeroen J.G. van Merrienhoer (that is: determine the learning task, look for the supportive information, provide the instant information, and design part-task practice), this paper follows the guiding principles of 4C four-component instructional comprehensive design learning theory and situational cognition theory, supplemented by the specific lesson examples, to explore the design of multimedia courseware for English class.

Keywords: 4C design model; multimedia courseware; orientation.

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1 Introduction

The application of different symbolic modalities or their mixed modalities in communication activities is referred to as multi-modality. A text with a certain meaning can be constructed by using different linguistic symbols and non-verbal symbols (Xiaoling, 2017; Xu, 2015). The study of the multi-modal theory is based on social semiotics. Social semiotics is based on systemic functional grammar (Hu, 2020; Yan, 2019), in which people are regarded as the 'para-promise' phenomena or the 'non-verbal sign' phenomena in the pictures, audio, videos, visual symbols, and so on, which are essential components of human communication activities (Pan, 2019; Liu and Ning, 2017). It has broken through the long-term misunderstanding of people that 'para-language' is placed in the auxiliary status (Geng, 2018; Ni, 2020) and equates 'para-language' with text symbols, which are jointly involved in the construction of the significance of discourse analysis (Prado, 2021; Liu, 2017). Domestic scholar Hu Zhuanglin analysed the multi-modal theory and its phenomena from the perspective of social semiotics (Liu, 2020; Jung, 2016), defined the concepts and categories of multi-modal semiotics and multimedia semiotics, and studies general semiotics, social semiotics, computer semiotics, symbol systems, symbolic resources, multi-modal symbol design, coherence, recognition of multi-modality, and other essential concepts (Lindell, 2013; Yang and Wang, 2013). Professor Gu Yueguo conducted a comparative analysis of multi-modal learning and multimedia learning and explained the concepts of single media, multimedia, single-modality, and multi-modality, respectively (Li et al., 2017).

At present, higher education is undergoing significant changes, that is, the shift from emphasising the impartation of knowledge and intelligence training to stressing the ability and emotional training, a change from 'the view of cultivating knowledge-based talents' to 'the view of cultivating innovative talents'. In this process, a scientific education concept with students as the main subjects of teaching and teachers as a guiding factor is established. In the same way, foreign language education also needs to shift from the acquisition of knowledge to the cultivation of innovation ability, application ability, and comprehensive quality urgently, a change from the teaching model of 'passive transmission' to the teaching model of '4C four-component instructional comprehensive design model'.

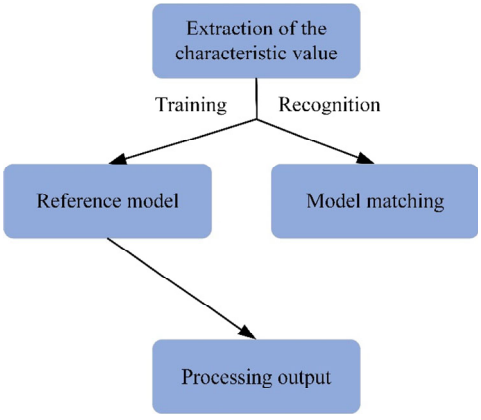
2 4C four-component instructional comprehensive task design model

The 4C four-component instructional comprehensive design model was developed by Jeroen J.G. van Merrienhoer, a professor at the Open University of the Netherlands (Open Universiteit) and a PhD in Educational Technology.

Professor Jeroen J.G. van Merrienhoer began to engage in research in the field of educational technology and instructional design in the 1980s. His early study projects mainly involved software engineering, fault detection technology, and other curriculum design aspects. In the 1990s, Professor Jeroen J.G. van Merrienhoer's research interests turned to the design of learning tasks for complex cognitive skills. The 4C four-component instructional comprehensive design model he developed is the most comprehensive design model in recent years. It has been extensively used in the design of complex cognitive skills training in many professional fields in Europe and the United States. Recent studies have identified effective strategies for multimedia courseware design to enhance English language learning. These include iterative content development, incorporating communication tools, integrating collaborative elements, and designing critical thinking exercises (Song and Yue, 2021). The 4C four-component instructional comprehensive design has become the theoretical basis for the practice of many teaching reforms. Firstly, it emphasises the student-centered approach and believes that students are the main subjects in the learning process, the main entities of cognition and information processing, and the active constructors of the significance of knowledge. Based on the 4C four-component instructional comprehensive design model, students in English learning can not only acquire language knowledge but also learn to use language structure creatively, which has highlighted the subjectivity and autonomy of the students in the construction of significance. Secondly, the 4C four-component instructional comprehensive design stresses the importance of the learning situation and believes that the learning process of students is related to the real-world situation or similar to the real-world situation, which is an experience of the real-world situation. Only in the realistic social and cultural background can learners construct knowledge actively and effectively and reorganise the original knowledge structure with the help of social interaction and the use of necessary learning resources. Thirdly, the 4C four-component instructional comprehensive design learning theory believes that 'collaborative learning' plays a crucial role in the construction of the significance of knowledge, which emphasises the collaboration and communication between students, between teachers and students, and the interaction between students, teaching content, and teaching media. Finally, the 4C four-component instructional comprehensive design emphasises the design of a learning environment. It is believed that in the learning process, teachers should provide learners with various resources (including various types of teaching media and teaching materials), and encourage the learners to explore and complete the construction of significance actively so as to achieve their learning goals.

In English courseware teaching based on multimedia, the transfer of knowledge in traditional classrooms is completed before class; and the internalisation of knowledge is transferred from the original homework activities after class to the learning activities in the classroom. Based on the current situation and characteristics of English teaching at colleges and universities, Wang Sumin et al. designed a four-stage English multimedia courseware teaching model based on the teaching concept of English multimedia courseware, including the teaching preparation, memory comprehension, application analysis, and comprehensive evaluation in the classroom. Figure 1 shows the recognition process of English courseware, in which the extraction process is that the feature values of a large number of standard contents are calculated repeatedly by using multimedia technology, and the result thus obtained is the reference model. The recognition process is the pronunciation feature value input by the user, which is decoded by multimedia technology, as shown in the following Figure 1.

Figure 1 Flow chart of the extraction of courseware information based on the multimedia technology (see online version for colours)



The 4C four-component instructional comprehensive design model is an instructional design paradigm that explores the design based on the principles of holism. When talking about the new development of instructional design, Professor Jeroen J.G. van Merrienhoer said that an excellent comprehensive teaching design should not only provide students with comprehensive learning tasks but also offer strong support and effective guidance for the students in the whole learning process. In addition, it should also provide practice opportunities that can facilitate the students to achieve expected academic performance goals. In this regard, he put forward four components, that is, learning task, supportive information, instant information, and part-task practice. Among these four components, the learning task is the core, which is presented to the students in the form of an overall task in a hierarchy of tasks with the difficulty level ranging from simple to difficult. In the design of the learning tasks, it is necessary to present students with specific, realistic, and meaningful overall task situations, guide and facilitate the learners to make conscious generalisation and induction, reasoning and summary as the case may be, and complete the construction of cognitive schema accordingly. Supportive information refers to information that is conducive to learning and completing non-repetitive learning tasks. Instant information refers to the prerequisite information provided at any time for learning and completing repetitive learning tasks. Part-task practice refers to the additional practice designed to automate the learning tasks of repetitive skills. The interrelation of the above four components constitutes the essential environment for the implementation of complex learning tasks.

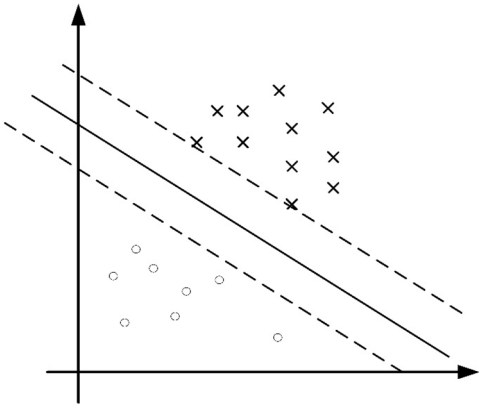
3 Quality optimised design process of the courseware guided by the 4C four-component instructional comprehensive design model

3.1 Construction of the teaching model

The design of the class teaching model should be based on the teaching objectives, the teaching content, and the characteristics of teaching subjects, where scientific system concepts and methods should be applied to select and design the teaching media

information rationally and combine them in the system organically to form an optimised structure of the teaching system. Starting with the teaching design principles of the 4C four-component instructional comprehensive design, the English exploratory class teaching model should reflect the basic characteristics of the learning process of students, such as subjectivity, contextuality, cooperation, and inquiry. In addition, it should also conform to the dominance, interaction, strategy, manoeuvrability, and a series of other cognitive and emotional characteristics in classroom teaching. In essence, the English exploratory class teaching model is to transform the traditional teacher-centred 'cramming or forced-feeding method of teaching' into a student-oriented and teacher-led 'exploratory' and 'collaborative' classroom teaching concept. While imparting language knowledge and skills, attention should also be paid to cultivating language use abilities, autonomous learning abilities, cooperative communication abilities, analysis and problem-solving abilities, and preliminary scientific research abilities of the students to maximise their enthusiasm and initiative in learning. In particular, collaborative group activities, peer to peer interactions and group projects are effective ways to promote shared learning and engagement. Students can learn from each other, motivate each other and improve together through these collaborative experiences. The design of the teaching model should follow an iterative process of developing content, integrating communication features to enable discussion, incorporating collaborative elements to promote teamwork, and including critical thinking exercises to encourage deeper learning. This iterative approach can enhance engagement and quality.

Figure 2 Schematic diagram of the 4C four-component instructional comprehensive design model



The 4C four-component instructional comprehensive design model is a classification algorithm based on the principle of maximising the greatest interval. Its core idea is to identify a hyperplane to separate all samples. In addition, the hyperplane should have the property of maximum separation; that is, the closest sample to the hyperplane has the largest distance from the hyperplane. Thus, the optimal classification surface should meet the following conditions:

$$\max_{w,b} \frac{2}{\|w\|}$$

$$s.t.\ y_i\left[\left(w\cdot x_i\right)+b\right]-1\geq 0,\ i=1,2,\cdots,n \tag{1}$$

In the above equation, $2 / \|w\|$ stands for twice the distance between the sample closest to the classification surface and the classification surface, and the constraint condition s.t. indicates that all samples should be correctly classified. As shown in Figure 2, the circles and crosses stand for two types of samples. The circles and crosses that fall on the dotted line are the samples closest to the solid line. If there is a solid line that maximises the sum of absolute distances between the closest circle and the cross, then this solid line should be the optimal classification surface.

The problem of solving the optimal classification surface can be transformed into solving a convex quadratic programming problem in which the objective function is a quadratic function and the constraint condition is linear, as shown in the following:

$$\begin{aligned}&\min_{w,b}\frac{1}{2}\|w\|^2\\&s.t.\ y_i\left[\left(w\cdot x_i\right)+b\right]-1\geq 0,\ i=1,2,\cdots,n\end{aligned} \tag{2}$$

As the collected data may be noisy or for the purpose of avoiding over-fitting issues, sometimes it is not desired that the samples should be perfectly separated by the hyperplane; that is, errors are allowed for the model on some samples. In the 4C four-component instructional comprehensive design model, the concept of 'soft interval' is introduced. In this way, some sample points may not meet the constraint condition $y_i[(w \cdot x_i) + b] - 1 \geq 0$, that is, their distance from the hyperplane can be less than one-half of the width of the maximum interval. The extent to which the samples are allowed to violate the constraints is represented by the slack variable ε, and the problem of solving the optimal classification surface is transformed to the following:

$$\begin{aligned}&\min_{w,b}\frac{1}{2}\|w\|^2+C\sum_{i=1}^{n}\varepsilon_i\\&s.t.\ y_i\left[\left(w\cdot x_i\right)+b\right]\geq 1-\varepsilon_i,\ \varepsilon_i\geq 0,\\&i=1,2,\cdots,n\end{aligned} \tag{3}$$

In the above equation, C is used to 'punish' those samples that are in violation of the constraints. The greater the C, the greater the punishment. Similar to δ, C is a hyper-parameter as well.

In the teaching process, teachers should be skilled in analysing the individual characteristics of the learners, take the cultural background, learning goals and learning interests of the students into comprehensive consideration, and design study topics in a targeted manner based on different teaching contents, focusing on cultivating the creativity, cooperation spirit, practical abilities, and other personal qualities of the students. Based on the 4C four-component instructional comprehensive design model, starting with the basic patterns of the cognitive activities of students, the characteristics of English teaching in our country are combined with the research findings of study courses both at home and abroad to establish s a design model for the teaching of the exploratory class 'English' in English majors based on multimedia network technology.

This type of exploratory class teaching model for English teaching based on multimedia network technology can be summarised into several main 'links' as the following:

1 scenario creation, interest stimulation, and schema activation

2 intensive instruction of the content (language, style, rhetoric, discourse, and so on), answering difficult questions and resolving doubts

3 focus on the texts and determine the topic (in-group discussion and inter-group discussion)

4 design the topic (questionnaire, interview, observation, and so on), division of work and collaboration with each other (document search, questionnaire design and survey, interview, text description, development of PPT courseware, and so on)

5 independent study, exchange and discussion, questioning and inquiry

6 presentation of the works (PPT courseware), evaluation of the results [self-evaluation, mutual evaluation, evaluation by the teacher (knowledge + capability)]

7 construction of the significance, submission of the paper (exploratory essay).

3.2 Lesson description and analysis

3.2.1 Content introduction

Textbook: New English Course Volume 2, Unit 11: A Virtue Called Devotion.

Introduction: The grandmother of the author is very old, weak and sickly, and quitestubborn and wilful. There have been several discussions among the family members on who would be responsible for taking care of her. In the end, the mother of the author decided to take the old man over and support her for life even though her house is not very big. This article shows the kind of dedication virtue of the author's mother. This article also includes an ancient and little-known story, which is also a great food for thought.

3.2.2 Lesson design and analysis

1 Determine the learning task: The learning task is to clarify and formulate the goal of the learning content, which plays a highly strong guiding and prescriptive role in the whole teaching activity. The topic of this paper is 'The virtue called devotion'. Hence, the main task of this lesson is to create a specific, realistic, and meaningful task situation with 'Devotion' as the main clue. For this purpose, a portrait of an old man is first selected, focusing on highlighting the lonely, helpless, but hopeful eyes of the old man. The establishment of this situation is originated from an important topic in the learning task of this lesson: Why such devotion is called virtue? The reason is that the first courseware required at this point is a situational scaffold that can lead to the topic so that learners can enter this situation and have a deep perception of the context where the problem exists.

2 Look for supportive information: that is, look for pictures and text contents that can represent the topic of this paper. Such type of supportive information can be obtained from multiple sources. They can be acquired from the Internet, or the chapters and chapters of the text contents to be learned can be used. The development of digital information technologies has brought about a huge volume of perceptual and fleeting information to stimulate the cerebral cortex with super high intensity. Teachers should make full use of this advantage and pay attention to the visual transmission effects when they choose the corresponding pictures.

In this case, it is required to look for two supportive resources: one supportive resource is picture information: two specific portraits of the lives of the elderly: one portrait is about an old man in the countryside with shabby clothes and poor mobility, but he is still struggling to collect firewood; the other portrait is about an old man in the city: Although he has no worries about food and clothing, he is alone in a luxuriant house, presenting a scene of inescapable loneliness. The other supportive resource is text information: Two types of text information are selected in this paper: the first type is a little-known story selected from the 8th paragraph of the article learned in this lesson. The content of the story is described as the following:

One day, a young man saw his father walking down the road carrying a large basket with difficulty. When he got closer, the young man could see that his old grandfather was in the basket.

> "Where are you taking Crandpa? Father?"
>
> "I'm taking him to the valley. He's old and mean and no good for anything now, so I'm going to throw him over the cliff."
>
> "'Okay, Father, you go right ahead,'hut he sure to save the basket. Someday I shall need it for you."
>
> "Where are you taking Crandpa? Father?"
>
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>
> "'Okay, Father, you go right ahead', hut be sure to save the basket. Someday I shall need it for you."

The second is to repeat the contents learned in the previous dialogues and reorganise the sentences.

Everybody ages. Old age is nobody's fault.

You can grow from a tomboy into a graceful lady, and then into a feeble, depressed old woman with childishly demanding and hardly put up with.

You can go through such an experience from the No. 1 mischief-maker to a well-groomed young man, to a forgetful, disliked and ailing old man, a burden to your children and the society.

The correct repetition means the extension of the knowledge previously learned, and the careful planning of repetition can enhance the confidence of the learners. Just like Professor Norbert Searle said in an interview about the methods and models in the research and development of instructional technology: "There are two forms of 'repetition': one is simple reproduction; the other is approximate repetition. The

latter can bring out the result with higher higher." Hence, in multimedia courseware, just like in the regular classroom teaching process, the solidification of the knowledge learned by learners cannot be separated from repetition. In this paper, the content of the previous dialogue is repeated in this section and reorganised accordingly.

3 Look for instant information: that is, to provide prerequisite information for students to complete the tasks as required. This information not only contains the direct understanding of the texts by the students based on the courseware but also the profound influence of the multimedia courseware on the students. Its forms can be presented by pictures or guided by questions design by the teacher. In the design of such practice, on the one hand, the teachers should pay attention to teaching learners to understand the full texts; and on the hand, they should also attach importance to the learning of the relevant vocabulary. The background knowledge of multimedia courseware should also include the background knowledge related to the language itself that is hidden behind a specific situation in addition to reflecting the background knowledge related to social culture, which can activate the sparks of thinking in the students to create the background knowledge related to the language itself, that is, the contextual knowledge or the speech structure.

4 Part-task practice: Professor Jeroen J.G. van Merrienhoer pointed out that: an excellent comprehensive teaching design should not only provide students with comprehensive learning tasks but can also offer vital support and practical guidance to the students in the whole learning process. In addition, it should also practice opportunities that facilitate the students to achieve expected academic performance goals. With respect to how much to generate and how to generate, design task practice is also very important in addition to the preset ones.

In the part-task practice of this lesson example, this paper focuses on the design of such a task situation that points to the learning of solving problems in the real context, that is:

One day, when we become an ailing man or woman, too feeble or too old to take care of ourselves, what might we expect at that time? Where should we go? (One day, when you become an ailing man or woman, too feeble or too old to take care of yourself, what do you desire most at that time?)

4 Case analysis of English multimedia courseware based on the 4c four-component instructional comprehensive design model

In the last year, the author and colleagues in the English group have applied the 4C four-component instructional comprehensive design model proposed by Professor Jeroen J.G. van Merrienhoer to design multimedia courseware and are deeply impressed by this model. We believe that this kind of teaching design paradigm from the holistic perspective can truly provide a novel way of thinking and a design framework for teachers in the design of multimedia courseware. That is, starting with the overall situation, the comprehensive teaching goals and tasks are determined. Similar to the several issues discussed in the paper by Jin Ling regarding the integration of information technology and curriculum, it is not difficult for teachers who think it through to find that

the reason for the application of technology is to optimise the process to realise the teaching goals. Subsequently, the unique advantages of the visual and audio provided by multimedia are leveraged to provide learners with supportive information. As demonstrated in the case, these supportive information resources can be media information resources and text information resources; or they can also be some questions designed by teachers. The real-time information provided by these information resources can not only provide some help for the learner to complete the next task but also offer vital support for the language output of their target language. In this way, in the entire task context developed, learning becomes an interactive communication in the real sense: the interaction between the contexts and the texts; the dialogue between the learners and the contexts; the mutual exchange, mutual communication, and mutual inspiration and complementation between the teachers and the students. In this process, the teachers and students share their thinking experience and knowledge with each other and communicate their emotions, experiences, and ideas, which can enrich the teaching contents and lead to new discoveries. Such a teaching model is a process of development, proliferation, and generation. This form of support provided to students to help them improve their existing abilities is also referred to by the designer of the 4C four-component instructional comprehensive design model as 'scaffolding'. Effective scaffolding can prevent the students from being overwhelmed or taking detours in their cognition process. This type of scaffold can be withdrawn gradually with the development of the learning abilities of learners.

Through teaching experiments, the team members carry out the independent sample t-tests on the pre-test and post-test teaching scores and total scores collected in the experimental class and the control class by using SPSS17.0 to test whether there are differences in the relevant variables before and after the two groups of experiments and whether the differences are significant. In addition, the results of the questionnaire survey are combined to analyse and discuss the reasons. The primary school English teaching model of the mind mapping software has significantly improved the English teaching level for the students at primary schools. Independent sample tests are carried out on the composition scores in the experimental class and the control class before and after the experiment in this study. The results are shown in Table 1 as the following.

Table 1 Statistics of composition scores of the pre-test group and the post-test group in the experimental class and the control class

	Number of students	*Mean value*	*Standard deviation*	*Standard error of mean value*
Pre-test in the control class	63	8.55	1.899	0.239
Post-test in the control class	63	9.71	1.226	0.155
Pre-test in the control class	66	8.53	2.046	0.252
Post-test in the control class	66	10.74	1.293	0.159

Table 1 indicates that in the English teaching at primary school based on the mind mapping software, the mean composition score in the experimental class is 10.74, and the mean composition score in the control class is 9.70; the amplitudes of improvement are 2.21 and 1.14, respectively. The standard deviation in the experimental class is decreased from 2.047 to 1.293, which suggests that the overall level of the composition teaching in the experimental class has been improved. From the test of the independent samples of pre-test and post-test essay scores in the experimental class and the control class, it can be

observed that the improvement in composition teaching level of the experimental class is significantly greater than that of the control class.

In this paper, investigation and interviews are carried out on the implementation and effects of the exploratory English class teaching model in the third grade of English majors. The content involves the learning interest, learning motivation, autonomous learning ability, scientific research awareness, and other aspects. The results indicated that after the implementation of exploratory class teaching, 90.3% of the students were very interested in English learning, and they were able to speak actively in class, with strengthened interactive communication in the English classroom teaching; 87.1% of students had a more clear purpose for English learning, and their motivation of learning is evidently enhanced; 83.9% of the students believed that in the process of accomplishing the project research, their independent learning abilities, information collection abilities, and the abilities to acquire professional knowledge had been greatly improved, and their confidence in English learning had also been enhanced; 87.1% of the students thought that the development of research teaching had improved their understanding of scientific research and stimulated their innovative consciousness and exploratory abilities to a certain extent; 80.6% of the students gradually realised the difference between academic paper writing and ordinary writing, noticed the academic standardisation and rigor of academic paper writing, and had a preliminary understanding of the senior thesis they were about to be engaged in; 93.5% of the students recognised the importance of collaborative learning in the process of accomplishing their project research.

5 Conclusions

The rapid advancement of computer networks and multimedia information technology and the continuous development of foreign language teaching theories have provided a lot of possibilities for the reform of English course teaching for English majors. Compared with the traditional teaching models that start with the internal structures of the language and attaches excessive importance to the language forms, the English exploratory class teaching model starts from the skills of language use and pays more attention to the cultivation of productive language skills, the research capabilities, and the active construction of knowledge. The design and development of the English exploratory class teaching model have incredibly aroused the enthusiasm, initiative, and creativity of students in learning. In summary, the key findings highlight that utilising the 4C comprehensive design model with an iterative, engagement-focused approach can optimise the quality of multimedia courseware for English language learning. This involves collaborative features paired with critical thinking exercises and peer interactions around developed content. Further studies can build on these findings to continue exploring effective strategies for optimising quality and engagement in English multimedia courseware. Some potential future research directions include: Conducting comparative studies on different multimedia design models to identify optimal approaches for quality and engagement. Examining the impact of emerging technologies like virtual reality for English learning engagement. There remain ample opportunities for further enhancing the design of engaging, high quality English language multimedia courseware through ongoing research.

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