

# An Exploration of Interdisciplinary Thinking Patterns in Secondary English Grammar Teaching-- Tenses

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**Abstract:** Interdisciplinary thinking is a way of thinking that utilizes the intersection and fusion between internal and external knowledge of disciplines to solve problems through cross-border integration of knowledge. The penetration of interdisciplinary thinking in secondary school grammar teaching is of great significance, which is conducive to change the conception of teacher's focusing on the teaching and research of their own disciplines merely, enhances students' interest in grammar learning, and promotes the development of students' multiple intelligence. In this paper, the author takes the tenses in secondary school English grammar as an example to explore the penetration of interdisciplinary thinking in grammar teaching. Specifically, the author takes the combination of mathematical and physical thinking in mathematics as an starting point, combining the "coordinate axes" with the "union sets" in the set to discuss the use of single mathematical model and the multiple mathematical models during the teaching of English tenses.

**Keywords:** Grammar teaching, Interdisciplinary thinking, Multiple mathematical models, Single mathematical model, Tense.

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## 1. Introduction

In order to cultivate talents of the times and implement the fundamental task of establishing moral education better, the Compulsory Education Curriculum Program (2022 Edition) issued by the Ministry of Education points out that "in principle, each course should use at least 10% of the class time to design interdisciplinary thematic learning", emphasizing that "to carry out interdisciplinary theme teaching and strengthen the synergistic nurturing function of the curriculum". The compulsory education curriculum program reflects the orientation of interdisciplinary learning clearly.

Professor Zhang Yuhua pointed out that interdisciplinary learning is a way of placing learning in an authentic, complex and meaningful context, integrating the knowledge, methods or concepts of two or more disciplines for problem solving, and realizing the purposes that cannot be achieved by a single discipline, to promote disciplinary and interdisciplinary understanding, to cultivate the ability of analyzing and solving problems from a multidisciplinary perspective, and to realize the enhancement of core literacy (Zhang, 2022). Interdisciplinary learning is actually an innovation to the traditional way of learning in separate disciplines, and this new way of learning helps to break down the barriers between disciplines, overcome the fragmentation of knowledge by traditional teaching in separate disciplines, and enhance the integration between the knowledge inside the disciplines and that outside the disciplines.

Interdisciplinary thinking is a way of thinking which is not confined to the boundaries of disciplines in curriculum and teaching, but emphasizes the intersection and fusion of knowledge within and outside the disciplines, and integrates the knowledge through crossing the boundaries to solve problems (Huang, 2021). It is the foundation of interdisciplinary learning, and only with this kind of thinking can we consciously explore the connection between disciplinary knowledge in learning, and consciously integrate and transfer knowledge, and finally realize creative problem solving. Under the orientation of interdisciplinary learning,

teachers are required not only to have interdisciplinary thinking themselves, but also to guide students to establish this way of thinking.

## 2. The Significance of Permeating Interdisciplinary Thinking in Grammar Teaching

### 2.1. Changing the Teaching Conception

On the one hand, most of the schools are still adopting departmental teaching, and the curriculum of each subject is constructed according to the knowledge system of the subject. Many teachers, under the influence of traditional teaching concepts, only focus on the teaching and research of the knowledge system of their own disciplines, and less involved in other disciplines, which leads to many teachers be overwhelmed in the face of certain disciplines at the intersection of the more comprehensive knowledge, lack of interdisciplinary knowledge and abilities to solve corresponding problems (Zhao, 2013). The traditional teaching concept of merely focusing on subject-based knowledge of the teaching method can not adapt to and meet the needs of the current comprehensive development of students. It is necessary that the current teaching concepts and teaching methods need to be updated and adjusted.

On the other hand, a study by Nature magazine on 88,000 published high-quality innovative scientific and technological papers around the world showed that the cross relationship between disciplines is getting closer and closer, which indicates that interdisciplinary innovation is gradually becoming a trend in the development of global science and technology (Zhong, 2021). Whether from the perspective of the needs of student development, or from the increasingly close intersection and integration between disciplines, teachers are required to change the concept of focusing only on the teaching and research of their own disciplines. They are required to abandon the teaching methods of fragmented knowledge teaching, and have the awareness and skills of interdisciplinary learning and teaching.

The penetration of interdisciplinary thinking in the teaching of grammar is breaking the traditional concepts and traditional ways of teachers and students. Grammar teaching is not only confined to the teaching of the English language subject, but also can be combined with the knowledge of the language, mathematical knowledge, and any other interdisciplinary knowledge of the cross-cutting and fusion of the relationship between the subject, which is not only a change in the concept of teaching, but also a kind of innovation in the teaching method.

It can be said that a change in the conception of teachers' teaching is not only an important value of penetrating interdisciplinary thinking in the teaching of English grammar, but also a manifestation of the significance of penetrating interdisciplinary thinking in the various sub-curricula.

## 2.2. Enhancing Learning Interest

Currently, grammar teaching in English classrooms of primary and secondary schools is still based on the traditional style as the main teaching method, and students just take notes in a dull way, unable to understand and think deeply about what the teacher has said (Hu, 2015). This kind of mechanical lecture grammar teaching not only makes students' interest in learning low, but also is not conducive to students' understanding and application of grammar knowledge. If teachers can consciously penetrate interdisciplinary thinking in grammar teaching, through the creation of specific teaching situations, integration and incorporation of interdisciplinary knowledge, on the one hand, it can greatly increase students' interest in grammar learning, on the other hand, it can also promote students to use knowledge in specific situations, enhance the understanding of grammatical knowledge and internalization.

## 2.3. Developing Multiple Intelligence

The development of an interdisciplinary teaching model requires teachers to abandon the inherent idea of practicing teaching for the development of a single intelligence in students, and to emphasize that the development of multiple intelligence in students should be the goal, so as to promote the comprehensive level of students.

As a language subject, English mainly helps to develop students' linguistic intelligence. However, it does not mean that English can only promote the development of students' linguistic intelligence. Under appropriate circumstances, if English teachers incorporate some numerical and logical reasoning knowledge into grammar teaching, it will help develop students' mathematical and logical intelligence; and if they incorporate some spatial, shape and graphic knowledge, it will be conducive to the development of students' spatial intelligence. Therefore, teaching English grammar under interdisciplinary thinking is conducive to students' mastery of English language knowledge and development of linguistic intelligence while strengthening the transfer and application of knowledge of other disciplines, deepening interdisciplinary knowledge, developing multiple intelligence, and thus promoting students' all-round development.

## 3. The Model of Interdisciplinary Thinking Infiltration in Secondary School Grammar Teaching--Taking Tense as an Example.

English tenses in secondary school consist of three kinds of "tenses" (time) and four kinds of "states", which cross-constituting a total of 12 common kinds of tenses, summarized in the following table:

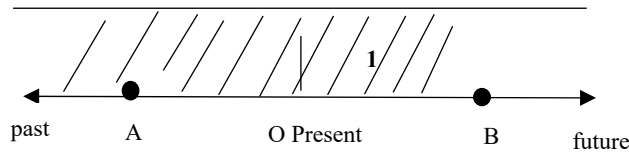
Table 1. Common tenses

	Simple	Continuous	Perfect	Perfect continuous
Present	do/does	am/is/are doing	have/has done	have/has been doing
Past	did	was/were doing	had done	had been doing
Future	shall/ will do	shall/will be doing	shall/will have done	shall/will have been doing
Past future (not common)	should/would do	should/ would be doing	should/ would have done	should/would have been doing

Tenses occupy a large proportion of English grammar in secondary schools and have always been a major problem for English teachers and students because of varieties and similar usage. When a variety of tenses are mixed together and explained, students are often prone to confuse the concepts and find it difficult to distinguish them. The following is an example of secondary school English tenses, discussing the infiltration of interdisciplinary thinking in grammar teaching, and mainly discussing the combination of mathematical thinking in mathematics, which makes the teaching of tenses simpler, more efficient and more interesting through the use of coordinate axes and sets of mathematics.

### 3.1. Single Mathematical Model

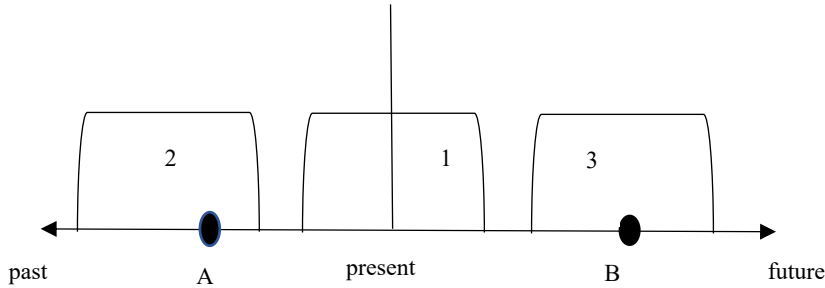
When explaining the time and state represented by different tenses, the coordinate axes in the subject of mathematics can be introduced. Horizontal coordinate axes in mathematics take point O as the origin, with rightward as the positive direction, the left side of the origin represents negative numbers, and the right side of the origin represents positive numbers, which precisely corresponds to the past, present, and future time in tenses. Therefore, different coordinate points and interval ranges can be used to present different tenses on the coordinate axes to make abstract concepts concrete, as shown below:



**Figure 1.** Past/present/future simple tense

The coordinate axis of figure 1 consists of three parts: past, present and future, in which area 1 represents the actions that often occur at the present stage and the objective facts and laws that exist, so area 1 can be used to represent the present simple tense. Point A represents the actions that occurred or

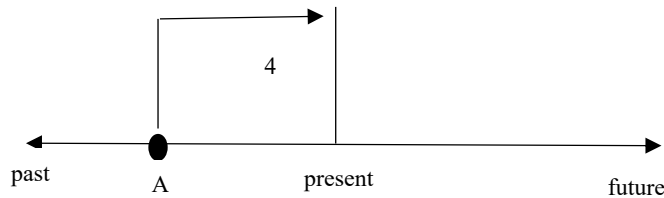
the states that existed at a specific time in the past, so point A represents the past simple, and point B represents the actions that will occur or the states that will be presented at a specific time in the future, so point B represents the future simple tense.



**Figure 2.** Past/present/future continuous

Since points on the axes are used to represent points of time when events occur, intervals can be used to represent the state of the action as it continues over a period of time. For example, in the figure 2, region 1 represents an action that is continuing at this stage, so region 1 can be used to represent the present continuous tense. Region 2 represents an action that is taking

place at some point in the past or at some time in the past, so region 2 can be used to represent the past continuous tense; region 3 represents an action that is envisioned to be taking place at some point in the future or at some time in the future, so region 3 can be used to represent the future continuous tense.



**Figure 3.** Present perfect tense

In the figure above, area 4 represents the present perfect tense with a semi-open range of intervals, which means the result or effect on the present of an action that happened or has been completed in the past, or an action that started at a certain point in the past, i.e., from time A, and has continued to happen until the present. The action that took place in the past has an effect on the present, which can be understood as "because the subject has done something that causes the

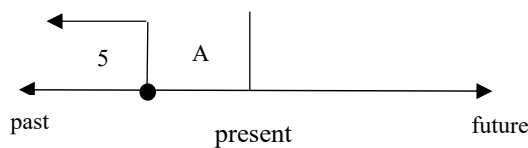
present..." An implication is implied.

Eg1: I have done all my homework.

The example sentence implies "I've done all my homework, so I don't have to do it now".

Eg2: They haven't seen each for six years.

This sentences indicate that they never saw each other during the six years and this kind of state lasts until now.



**Figure 4.** Past perfect tense

The past perfect tense can be presented on the above axis

with area 5 in figure 4, which indicates an action or state that

occurred before a certain point in time A in the past with reference to that time.

Eg: All the tickets had been sold out when they arrived.

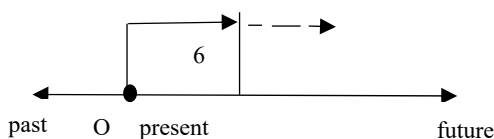


Figure 5. Present perfect continuous

The present perfect continuous tense can be presented on the coordinate axis with area 6 in figure 5, which indicates that with reference to a point in time O in the present, the action took place in the past and has continued until the present, and it is possible that the action has just ended or that it will continue to continue.

Eg: He has been living here since he graduated.

The difference between the present perfect continuous

tense and the present perfect tense is that the present perfect continuous tense has continuity of action, while the present perfect tense has no continuity of action. Take the above sentence as an example, the present perfect tense "He has lived here." means "He used to live here." And it is not known whether he still lives here, while the present perfect continuous tense means "He has been living here since he graduated", and he will probably continue to live here in the future.

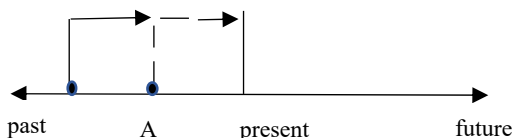


Figure 6. Past perfect continuous

The past perfect continuous tense indicates that with reference to a point in time A in the past, the action took place before this time and has continued up to this point in the past, and that the action may continue to continue in the future, which can be presented in figure 6.

Eg: He had been living here for ten years before he graduated.

The similarity between the past perfect continuous tense and the present perfect continuous tense lies in the fact that both can indicate the continuity of an action, while the difference lies in the different points of reference, with the former referring to a point of time in the past and the latter referring to a point of time in the present.

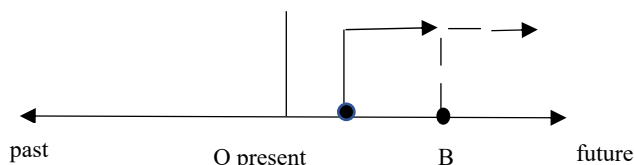


Figure 7. Future perfect continuous

The future perfect continuous tense is represented on the coordinate axis in figure 7 by reference to a future point in time B. An action that begins at a future point in time continues up to that point in time B, and may continue to do so, or may have just ended.

Eg: He will have been living here for ten years by the end of the month.

The common tenses in secondary school English can be explained clearly with the help of coordinate axes, and with the help of time nodes and intervals on the coordinate axes, we can more intuitively identify several groups of tenses with similar but slightly different usages. Through the penetration of the mathematical discipline of the combination of mathematical and physical thinking, combined with a single mathematical model of the coordinate axis, can give the originally boring grammar teaching with interest, the use of mathematical models also make the abstract grammar points more intuitive, which will help students to understand in-depth.

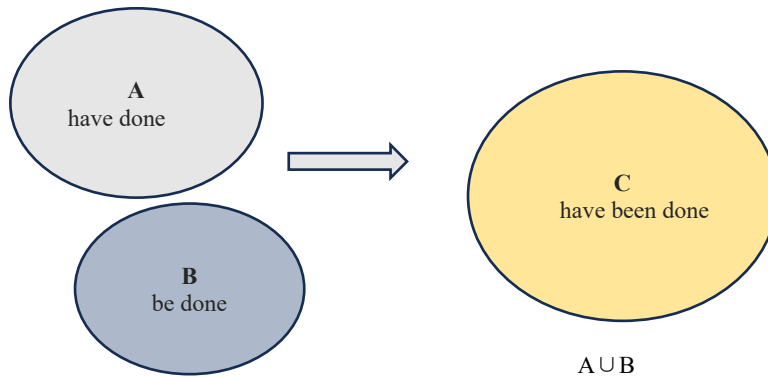
### 3.2. Multiple Mathematical Models

Secondary English tenses are often examined for their metamorphic usage, most often in the passive voice of several groups of perfect tenses. Using coordinate axes, teachers can explain the common tenses clearly, but when it comes to the combination of two or more tenses, the coordinate axes method is no longer applicable. Therefore, it is possible to consider the combination of several models in mathematics, such as "sets", and the following will discuss the passive voice of the perfect tense. Another way of understanding of perfect tense by using the use of union in sets will be introduced.

In mathematics, set A and set B, all the elements of the two sets are combine together to form a new set called the union of set A and set B, which is denoted as  $A \cup B$ . Though sets can not be added directly in mathematics, in order to make it easy for the students to understand when introduced into the English tense teaching, union can be indirectly understood as the addition of the two sets. Take the passive voice of present perfect "have been done" as an example. We can regard the

present perfect "have done" as set A, and the passive voice "be done" as set B. The combination of set A and set B requires both the passive state of the action in the present perfect tense and the completed state of the action in the passive voice, so the condition of both needs to be fulfilled

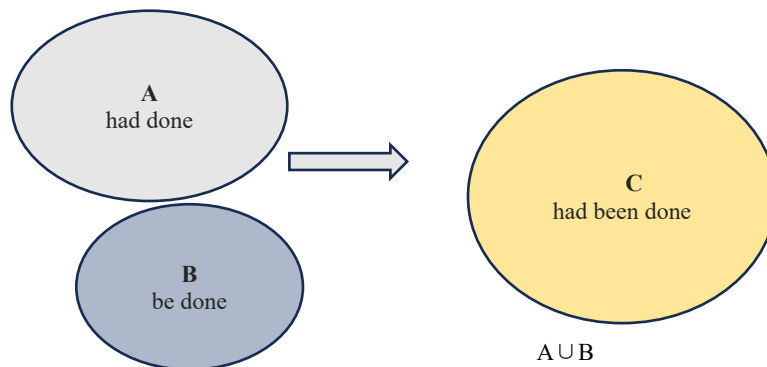
can be solved by changing the verb "be" into the past participle "been". Therefore, the concatenation of set A and set B forms the passive voice of the perfect tense "have been done", which is represented by set C, and can be represented graphically as follows:



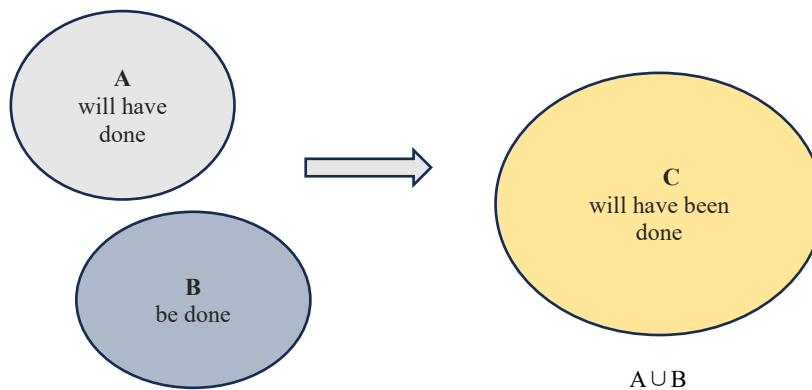
**Figure 8.** The passive voice of present perfect

Similarly, the passive voice of the past perfect and the passive voice of the future perfect can be expressed in the

same way:



**Figure 9.** The passive voice of past perfect



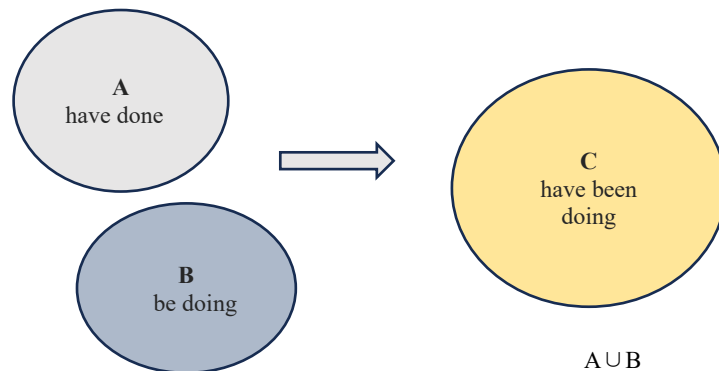
**Figure 10.** The passive voice of future perfect

In addition to the passive voice of the perfect tense, the perfect continuous tense can also be taught in the form of

union sets. For example, take the present perfect continuous tense "have been doing" as an example. The present perfect

tense "have done" is regarded as set A and the continuous tense "be doing" as set B. When combining set A with set B, in order to transform the perfect tense into a state where the action continues to take place, but also to reflect that the action took place at a certain moment in the past in the continuous tense, we only need to change the verb "be" into

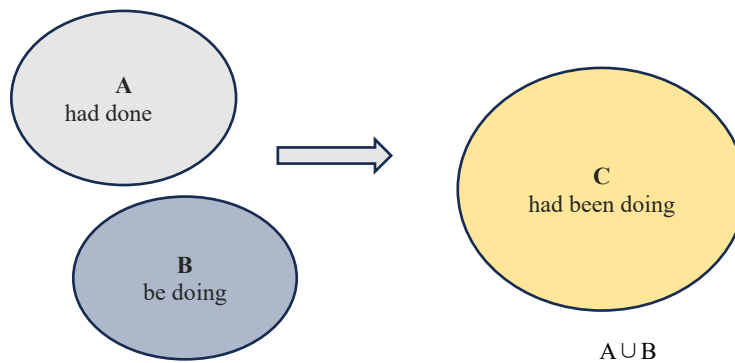
the past participle "been" to satisfy these two conditions at the same time, and thus the combination of set A and set B will form the present perfect continuous tense "have been doing", represented by set C, which can be represented graphically as follows:



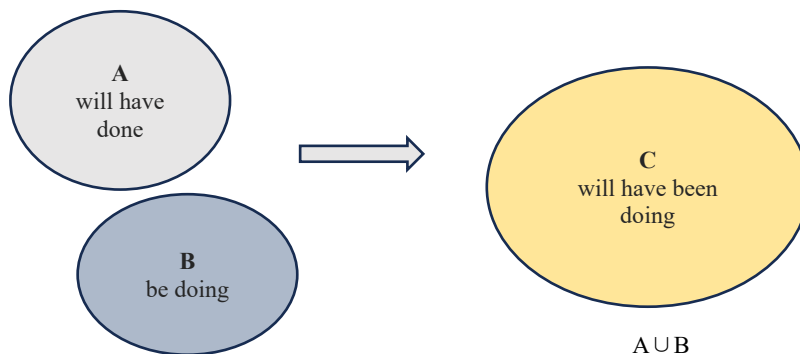
**Figure 11.** Present perfect continuous

Similarly, the past perfect continuous tense and the future perfect continuous tense can be represented in the same way,

as shown below:



**Figure 12.** Past perfect continuous



**Figure 13.** Future perfect continuous

#### 4. Conclusion

Whether the use of a single coordinate axis or the union set to explain tenses, they both can make abstract grammatical knowledge visualization, make the process of explanation

easy to understand and interesting. The use of mathematical knowledge in English grammar teaching and learning not only realizes the transfer and innovation of interdisciplinary knowledge, but also further consolidates and internalizes the original subject knowledge in the process of using

interdisciplinary knowledge. In short, the process of penetrating interdisciplinary thinking in grammar teaching is not only the process of transferring and applying interdisciplinary knowledge, but also the process of internalizing and consolidating the original subject knowledge. Teachers should be active and adept in guiding students to establish the awareness of interdisciplinary learning, master the ability of interdisciplinary learning and integration, ultimately promote the development of students' comprehensive abilities.

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