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# Study on the Application of Learning Transfer theory in Senior High School Mathematics Teaching

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***Abstract*** **– Learning transfer generally exists in all aspects of mathematics learning in senior high school. Training students to master the law of learning transfer can help students improve learning efficiency and mathematical ability in all aspects, which plays an important role in achieving educational goals. Through the investigation and analysis of the application of learning transfer in senior high school mathematics teaching, it is concluded that the factors that affect the transfer of senior high school students' mathematics learning are: the commonality of the new and old knowledge of senior high school mathematics; the similarity of learning situations; the students' general level of mathematics learning content; the students' mathematical cognitive structure; the students' learning set; the influence of teachers, etc. The strategies to overcome the lack of application of the current learning transfer theory and cultivate students' learning transfer ability include: attracting students' interest in learning, giving full play to students' initiative in learning; connecting new and old knowledge, improving students' mathematical cognitive structure; grasping the essential characteristics, improving students' generalization ability; training analogy ability, promoting the occurrence of transfer; carefully arranging exercises, and cultivating students' positive thinking transfer.**

***Keywords*** **– Learning Transfer, Senior High School Mathematics, Students, Training Ability.**

## I. Questions Raised

The goal of education put forward in the outline of basic education reform (Trial) issued by the Ministry of education is to let students learn how to study. That is to say, the examination oriented education which only pays attention to the examination scores is gradually transformed into the quality education which can improve the ability of analyzing and solving problems. The content of knowledge points in each chapter of senior high school mathematics is very logical, and the relationship between mathematics and other disciplines is also very close. In the learning process, if we can transfer between mathematics knowledge and knowledge or between mathematics knowledge and other knowledge, we will achieve the learning effect of twice the result with half the effort. Transfer is a very common phenomenon in the process of learning. To cultivate students' ability of learning transfer requires teachers to gradually change from the past as the leader of education to the organizer and guide of education. They only play an auxiliary role and give full play to students' learning initiative. Migration can make students fully prepared for further in-depth knowledge learning and ability improvement. It can optimize the effect of teaching and ultimately achieve a more comprehensive development of students.

## II. Classification of Learning Transfer

According to different research standards, there are different classification methods for learning transfer.

### A. *According to the Nature of Migration, Migration can be divided into Positive Migration and Negative Migration*

Positive transfer is a kind of positive transfer, also known as promoting transfer. For example, if students learn the solution of quadratic equation of one variable, they will inspire and promote the learning of the solution of

quadratic inequality of one variable. Negative transfer is a kind of disturbing transfer, also known as inhibitory transfer. For example, students have learned the law of multiplication distribution in primary mathematics, such as $a\times(b+c)=a\times b+a\times c.$ However, in the trigonometric function part of the senior high school mathematics required four textbooks, we learned Formula $\sin(\alpha+\beta),$ where $\sin$ is the name of trigonometric function, not a specific letter or formula, and its correct expansion should be $\sin(\alpha+\beta)=\sin\alpha\cos\beta+\cos\alpha\sin\beta$. However, due to the influence of early learning, many students will write the expansion as $\sin(\alpha+\beta)=\sin\alpha+\sin\beta$ by mistake, which is the consequence of negative transfer.

B. *According to the Direction of Migration, Migration can be divided into Forward Migration and Reverse Migration*

Forward transfer refers to the influence of previous learning on later learning. For example, if students learn the image and related properties of exponential function, they will be helpful when learning the image and related properties of logarithmic function, which is a kind of forward migration. Reverse transfer refers to the influence of later learning content on previous learning. For example, when we study the image and properties of tangent function in compulsory textbook 4, we know that the independent variable of tangent function is. This is the definition domain of tangent function, that is to say, tangent function has no meaning at that time. After making this part clear, we can have a deeper understanding of the slope of the straight line when the inclination angle of the straight line is, but there is no meaning, so the slope of the straight line does not exist.

C. *According to the Hierarchy of Migration, Migration can be divided into Horizontal Migration and Vertical Migration*

If the generality and logicality of the two learning contents are at the same level, the transfer between them is horizontal transfer, also called horizontal transfer. For example: the image and properties of sine function and cosine function in trigonometric function part, the generality of their two parts of learning content is at the same level, and the logical relationship is also juxtaposed, so the impact between them can be called horizontal migration. If the two learning contents are different in difficulty, generality is not at the same level, and logicality is not parallel, then the transfer between them is vertical transfer, also known as vertical transfer. Vertical transfer is also divided into two types: one is vertical transfer from bottom to top, that is, simple, more detailed and specific learning has an impact on difficult, more abstract high-level learning, which is a generalization process from particularity to generality. For example, from the number index operation to the letter index operation, it is a vertical transfer from the bottom to the top. The other is the vertical transfer from top to bottom, that is, the influence of the more abstract high-level learning on the simple, more detailed and specific learning, which is a general process from generality to particularity. For example, the learning function can better explain the related content of the learning of the sequence part, which is the vertical migration from top to bottom.

D. *According to the mode of Migration, Migration can be divided into Special Migration and Non Special Migration*

Special transfer refers to the transfer of knowledge and skills that have been learned to other learning directly, just to re integrate the acquired content and then misappropriate it to other learning, which is aimed at the transfer of knowledge and skills. For example, when we learn the properties of the definition domain, value domain, parity

and monotonicity of the function, and then learn the image and properties of the power function, we can naturally transfer to study the definition domain, value domain, parity, monotonicity and other related properties of the power function. Nonspecific transfer, also known as general transfer, refers to the transfer of more abstract and generalized general principles, methods, attitudes, etc. to other specific learning. In short, it is to embody abstract principles. It can transfer the learned content to a wider knowledge field. For example, when we study curve equation, we learn how to find the trajectory equation of a moving point. Then, when we study the trajectory problem of a moving point in hyperbola, we can solve the problem with the help of the ideas and methods learned in curve equation, which is non-specific transfer.

## III. Investigation and Analysis of the Application of Learning Transfer in Senior High School Mathematics Teaching

### A. *Current Situation Investigation*

In order to make the survey results more scientific, a questionnaire about the current situation of high school students' mathematics learning transfer was designed. A total of 420 students from 8 classes in grade 2 of the first senior middle school in Hunchun City, Jilin Province were surveyed. The results are shown in Table 1.

Table 1. Statistical Table of Questionnaire Results.

| Number Data Option | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 74.2% | 48.1% | 17% | 87.3% | 51.2% | 93.7% | 83.1% | 45.5% | 73.2% | 62.4% | 63.6% | 7.2% |
| B | 22.4% | 31.4% | 26.8% | 9.5% | 43.6% | 5.3% | 20.9% | 45.2% | 29.8% | 31.1% | 30.7% | 11.4% |
| C | 3.4% | 20.5% | 56.2% | 2.2% | 5.2% | 1% | 6% | 10.3% | 7% | 16.5% | 5.7% | 81.4% |

### B. *Analysis of Investigation Results*

According to the results of the questionnaire, the data are analyzed and sorted out, and the factors that affect the transfer of high school students' mathematics learning are as follows:

#### 1. *The Commonality of New and Old Mathematics knowledge in Senior High School*

According to the theory of common elements put forward by sandike, we know that there are common elements in the two kinds of learning content before and after the transfer can happen. Therefore, in order to achieve learning transfer, students should focus on finding the commonality between the new and old knowledge, which is why in the survey results, most teachers should review the old knowledge related to the new course before teaching it. The more common elements exist between the new and old knowledge, the higher the commonality, the more likely the transfer will occur, and the more beneficial the new knowledge will be learning is easier for students to accept, and the teaching effect is more obvious. The commonality between the new and old knowledge includes not only the surface feature similarity, but also the essential feature similarity.

#### 2. *Similarity of Learning Situations*

High school mathematics is highly abstract. Many students can't understand and master it well when they learn it. Sometimes they can only remember it mechanically. In this case, if we can not fully digest and understand knowledge, we can not use it flexibly. Sometimes, if teachers can skillfully set up some learning situations related

to the content of this section, guide students to generate ideas, and help students to strengthen memory, students can experience the richer and more diverse side of knowledge concept in this complex situation, and then grasp the essential attribute more accurately, and understand the knowledge well.

3. *Students' General Level of Mathematics Learning Content*

The transfer of mathematics learning is the influence of the knowledge experience skill attitude learned in one kind of learning on the knowledge experience skill attitude of another kind of learning. The key to a smooth transfer is to accurately summarize the common elements between the two learning situations. The students' generalization level of learning knowledge experience can objectively reflect their understanding degree and knowledge of the two knowledge links the degree of knowing the essence of knowledge. The more thorough the understanding of the commonality and regularity between the two learning activities, the clearer and accurate the generalization will be, and the more conducive to the occurrence of learning transfer. The results show that some students will summarize and summarize some knowledge points, mathematical ideas and mathematical skills when they are doing the questions, which is a very good learning habit. It is helpful to refine the investigation points accurately, clarify the items, and improve the students' generalization level. Teachers should pay more attention to the guidance of such learning methods in ordinary times, and let students generalize and summarize, so as to avoid the practice mode of the sea of questions tactics. Generally speaking, the higher the students' generalization level is, the stronger their ability is. When they learn new knowledge, the better their understanding of the principles will be. Later, in the process of solving new problems, the more likely they are to have migration, and the more significant the effect of migration is.

4. *Students' Mathematical Cognitive Structure*

The cognitive structure of mathematics is the whole knowledge content and organization that learners understand, internalize and store in memory for a long time. The retention of knowledge and experience in learners' mind, as well as the stability and clarity of memory will directly affect the occurrence of transfer. Transfer is a process of interaction and integration between the content of new learning and the existing cognitive structure in the brain. Therefore, students' good mathematical cognitive structure becomes the key to study new problems. If the cognitive structure of the students is clear enough with high distinguishability, the connection between knowledge and knowledge will be smoother, the level distinction will be clearer, and the logicality will be stronger. The students will be more clear about where to use it to transfer. It can be seen that a good cognitive structure has a positive role in promoting the transfer. Therefore, students' cognitive structure has high clarity, stability, availability and discrimination, so when learning new knowledge, they can accurately find the relationship with the old knowledge, mobilize this part of knowledge, categorize and reorganize the problems clearly, and make full use of the knowledge structure to maximize the role of existing knowledge and experience, which will be easier to produce in the process of learning Migration, and the effect is significant. On the contrary, if the cognitive structure of students is not good, the knowledge is disordered, the induction and classification are not clear, it is difficult to find the connection point between the new and old knowledge, or even affect the learning of new knowledge due to the previous wrong learning experience, leading to the occurrence of negative transfer.

5. *Students' Learning Set*

Learning stereotype refers to that the previous learning experience often becomes a kind of preparation state f-

-or the subsequent learning experience, which is usually manifested as a tendency. Students tend to use the knowledge, thinking mode and solution strategy accumulated in the previous learning activities to treat the subsequent learning. Learning set is a kind of inertial thinking that students naturally produce after using the same mode and method to deal with some problems. It is a necessary factor to form the set that students can see the repeated learning activities. However, because learning stereotype is a kind of tendentious thinking, it can cause both positive and negative transfer. As the survey results show, there are many students who can use the learning formula to solve problems, but sometimes the results are correct, sometimes the errors occur. It can be seen that if the subsequent learning content and the previous learning content are the same type of problems, then the learning set will promote the occurrence of positive transfer. On the contrary, if we can't get rid of the surface features, and can't realize whether the follow-up learning content is related to the previous learning content in essence and whether there is difference, it is easy to have a single thinking mode, inflexible and inflexible, and copy the inherent learning mode mechanically, resulting in negative transfer, which affects the learning effect of students.

6. *The influence of Teachers*

First of all, the accuracy of teachers' knowledge will affect learning transfer. Teachers should have a thorough understanding of what they are teaching, be able to grasp students' learning situation objectively, and design courses according to the actual situation. The language of the teacher's lectures must be rigorous and accurate. The more these aspects are done in place, the more accurate the students' grasp of the essence of mathematical knowledge will be, and the more it will promote the occurrence of positive transfer in students' learning process. Secondly, teachers' teaching methods and design will affect learning transfer. In teaching design, teachers must fully consider students' cognitive level and understanding ability, adopt teaching methods and teaching models that are more easily accepted by students to make students better understand mathematics knowledge, guide students to expand their thinking, actively acquire knowledge, achieve the goal of cultivating various abilities and innovative consciousness, and then flexibly learn what they have learned knowledge and experience are combined with other learning contents to promote the occurrence of learning transfer.

## IV. Strategies for Cultivating the Ability of Mathematics Transfer of Senior High School Students

### A. *Stimulate Students' Interest in Learning and Give Full Play to their Initiative in Learning*

As we all know, "interest is the best teacher". Interest can arouse students' initiative in learning, improve their attitude towards learning, stimulate students' desire for research and exploration, make students more attentive and more active in thinking and actively solve the problems found, so as to promote the occurrence of learning transfer.

First of all, we should make more connections between mathematics knowledge and daily life practice. Mathematics knowledge comes from life, and ultimately also serves life. Connecting and transferring the living examples around students with the mathematics knowledge in textbooks can make students more familiar, increase their sense of identity, and attract more interest of students. This can not only enrich and connect the content of mathematics courses, but also facilitate the occurrence of migration in the learning process of students. Secondly, the use of multimedia technology to enrich the classroom, to attract the interest of students. Compared with the

boring and abstract traditional teaching methods, multimedia teaching methods can display the learning content more vividly, stereoscopically, interestingly and vividly for students. For example, when explaining the ellipse and its standard equation, first determine two fixed points on the plane, then fix the two ends of a rope on two fixed points (the rope length is greater than the distance between the two fixed points), put the pen tip on the rope and straighten the rope, move the pen tip, and the trajectory formed by the pen tip on the plane is the ellipse. In addition, change the length of the rope or the distance between the two fixed points to realize the influence of the change of eccentricity on the change of ellipse shape. These aspects can be displayed to the students more intuitively by using the geometric sketchpad and other multimedia means. The students feel that the rigid written words are transformed into dynamic graphics, and their enthusiasm for learning can be greatly improved and their initiative for learning is stronger.

### B. *Connect New and Old knowledge and Improve Students' Mathematical Cognitive Structure*

Mathematics knowledge is always linked, and the learning of new knowledge is always based on the mastering of old knowledge. High school mathematics textbooks are compiled in a spiral way. Therefore, some knowledge that was originally closely related is scattered in the textbooks, which is not very beneficial for students to learn new knowledge. Therefore, in the process of mathematics teaching, teachers must pay attention to preparing textbooks, teaching methods and students, try their best to follow the logical structure, integrate the old knowledge with the new knowledge, so that students can make clear their knowledge if students can build a good cognitive structure and structure of mathematical knowledge and form a knowledge network, it will help them to find the relationship between the new and old knowledge accurately and quickly, and it will be more conducive to new knowledge learning. When teaching, teachers should consider students' existing mathematical knowledge more, choose typical cases to analyze, fully combine them, connect old knowledge with new knowledge as much as possible, and actively promote the realization of migration. At the same time, we should distinguish the differences between the old and the new knowledge in time to avoid confusion, and further improve the cognitive structure of students.

### C. *Grasp the Essential Characteristics and Improve Students' Generalization Ability*

Mathematical generalization ability refers to the ability to sum up different mathematical knowledge or different kinds, different parts and similar and essential contents of the same mathematical knowledge. The key to students' ability of mathematics transfer lies in their ability of summarizing problems. Students' generalization ability directly affects the mastery of mathematical concepts. Without generalization, students will not understand mathematical concepts, nor master the theorem, formula, rule, etc. extended from mathematical concepts, nor be able to flexibly use mathematical knowledge to solve various problems. The original complex and abstract mathematical knowledge system will not be well digested due to the lack of generalization ability of students, various mathematical abilities cannot be formed, and mathematical cognitive structure cannot be established. Only when students generalize the general principles of their existing mathematical knowledge and learning experience can they better transfer these knowledge from one learning situation to another. The process of students' generalization of knowledge is the process of sublimating knowledge structure into cognitive structure, which is the process of knowledge intellectualization. It can be seen that generalization learning is meaningful learning. In the daily teaching, teachers should not only let students know what it is, but also let them know what it is. But in many cases, because of the constraint of teaching progress, some teachers will directly give mathematical

theorems and conclusions, ignore the derivation process, or pay more attention to how many questions are told in the exercise class, and pay no attention to the learning state of the students. On the surface, the students will do the questions, but this is just a superficial false grasp, and do not have a deep understanding of the essence of mathematical knowledge. These teaching methods are not conducive to the improvement of students' ability, can not promote the generation of migration, can not achieve the comprehensive development of students. Therefore, when explaining exercises, teachers should fully show their own thinking process, for example, where to start thinking after seeing the questions, why this kind of thinking will come into being, how to determine the types of questions, and how to compare the advantages and disadvantages of different methods of solving questions with students' solutions. In this process, they should build their own thinking process and summarize how knowledge points are application, how to solve different types of problems.

### D. *Training Analogy Ability to Promote Migration*

Analogy is a kind of reasoning. It compares two different problems. According to their similarities in some aspects, it also knows that one problem contains other attributes, and infers that another problem also contains this attribute. Two of them have similar attributes, that is, common elements. In mathematics teaching, it is often applied to analogical thinking method. Analogical thinking method enables students to find the same structural features of the two, recall and associate the similar laws with the past through careful observation when learning new and old knowledge, classify the similar problems into different categories, and reveal the common essential attributes of similar problems and the relationship between them in order to generate the transfer of thinking, the methods and strategies to solve the similar problems before are applied to the process of solving new problems, so as to solve the target problem by analogy with the former. According to the theory of common elements, the more common elements between the two kinds of learning, the greater the effect of previous experience, and the more likely the transfer will occur. Therefore, the training of students' Analogical reasoning ability can make the transfer happen more naturally and the effect of transfer better.

### E. *Arrange Exercises Carefully to Cultivate Students' Positive thinking Transfer*

In the past, some teachers are good at using the method of increasing the amount of practice to improve the students' ability of solving mathematics problems, which are sometimes highly repetitive. Although this kind of training has certain help to students' mathematics achievement, it is easy to cause students to feel bored and tired of mathematics subject due to a large number of mechanical repetition, and finally lose interest and learning motivation. Moreover, the training of mechanical repetition is not conducive to the flexibility of students' analysis, the divergence of students' thinking and the occurrence of transfer in learning. Therefore, when arranging exercises, teachers should carefully analyze students' learning situation, select typical topics scientifically and reasonably, set up a good benchmark, and then carry out the design of variable training in a hierarchical way, so that students can gradually compare and think on the basis of examples, carry out micro migration, and find reasonable solutions. In the process of arranging exercises, teachers should not be eager for success. They should follow the principle of step-by-step in psychology pedagogy, and gradually train students' flexible ability of using knowledge and skills of solving new problems. In addition, when explaining exercises for students, teachers should consciously guide students to refine the basic knowledge theorem involved in the exercise stem, pay attention to training students' ability of analysis and generalization, and also summarize the key knowledge points and training ability in the exercise, help students to clear their mind and accumulate experience, so as to make

proper knowledge storage for students in solving new problems in the future Preparation and capacity accumulation.

## V. CONCLUSION

The educational goal put forward by the educational reform is to let students learn to study, which is meaningful learning. Learning transfer theory plays an important role in cultivating students' abilities in all aspects and improving their comprehensive quality. It reflects students' abilities in finding and asking, analyzing and solving problems. It also reflects whether students have good cognitive structure and good generalization level. It is a standard to test whether students' learning is meaningful. Therefore, it is necessary to study learning theory Yes. The purpose of studying the transfer theory is to apply the transfer theory to the practical teaching, to improve the level of education and teaching of teachers, to improve the efficiency of students' learning, to cultivate students' mathematical core literacy, and finally to realize the all-round development of students.

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