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Logarithm Concept Teaching in Teaching “Present Reasons”

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ABSTRACT

Two key points of logarithm concept teaching design view are examined in this study. “Present Reasons” educational theory is examined for purpose of achieving profound understanding of subject content. Academic course subject content analysis is conducted to determine learning difficulties through investigating initial point of student cognition. Methods are then designed for bypassing study challenges from multiple levels and angles.

Keywords Logarithm; Variation theory; Historical genetic principle; Recreation; Present Reasons

SUBJECT CLASSIFICATION Mathematics education

INTRODUCTION

"Present Reasons" in teaching refers to clear context presentation, student internal connection and the essential characteristics of knowledge according to choice of teaching content. Considerations for both teacher and student knowledge are made as inspirational teaching utilizing guidance and encouragement is advocated to achieve natural growth in the dynamic balance of teaching and learning to arrive at an effective teaching method through "Present Reasons ". [1]

Specific theories as applied to the complex system of teaching are difficult to establish in guiding teaching for all courses. Stylistically, classroom teaching can be considered as the "Present Reasons" approach. Various teaching methods exist under the guidance of diverse theories with each featuring unique characteristics possessing innate advantages and disadvantages. We can only say that flowers contend in fragrance and fascination. Teaching methods; however, are employed often with minimal genuine comprehension of effectiveness. Classic education theory that we study, historical principle, Marten mutation theory, to create learning theory, APOS (Students learn the concept through “action, process, object and scheme” four stages) theory, and as our local education theory, heuristic teaching, teaching style, etc., actually there is no conflict theories mentioned here, but complement each other, glowing from the vitality of life in the wide application. The Logarithmic teaching concept was observed in two different secondary schools with different teaching styles based on the shared perspective of HPM (History and Pedagogy of Mathematics). So based on the theory of the education of "Present Reasons" and the perspective of HPM, there is also to talk about the teaching of the concept of logarithmic.

A. TWO KEY POINTS OF LOGARITHM CONCEPT TEACHING DESIGN

1. New lesson introduction

Logarithm of development, from human ingenuity to find ways to solve a multiplication and division to calculate the huge obtained, that is: between the "arithmetic" and "geometric" to find a corresponding use of this relationship, the multiplication and division operations, converted into addition and subtraction to deal with. For example: To calculate 16X128, can be found corresponding to 16,128 (2's) power, i.e., 4 and 7, from 4 + 7 = 11, 11 to find the corresponding value of 2048, you can learn 16x128 = 2048.

Table1. The “arithmetic” (tolerance to 1) and “geometric” (ratio is 2) numerical corresponding table.

4+7=11

-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12
1/8	1/4	1/2	1	2	4	8	16	32	64	128	256	512	1024	2048	4096

16×128=2048

In this correspondence, the so with the logarithm tables forming, and, later, the popularity of the slide rule, and promoted the development of the whole of astronomy, navigation. This correspondence should be the definition of the most original of the logarithm, the results later attributed to Scottish Napier (JohnNapier, 1550-1617) and Switzerland Bulki (Joost Burgi, 1552-1623).

Prior data preparation is integral to explaining the history of mathematics and mathematics teaching. Logarithmic development in teaching originates from this history yet does not involve prior student knowledge of arithmetic and geometric to achieve the teaching method as applied to diverse curriculum.

Utilizing Table 1 above to determine meaning of the arrows, students typically provide accurate answers. Then, give the following table 2, the inquiry with the above should be any different.

Table2. The “arithmetic” (tolerance to 3) and “geometric” (ratio is 2) numerical corresponding table

12+18=30 ?

-12	-9	-6	-3	0	3	6	9	12	15	18	21	24	27	30	33
1/8	1/4	1/2	1	2	4	8	16	32	64	128	256	512	1024	2048	4096

32×128=4096

Teachers guide students to learn how "geometric sequence" corresponds with "arithmetic progression" and how to deal with multiplication and division through changing addition and subtraction. Table 3 and Table 4 are then presented for observation to enhance the above-described results.

Table 3. The “arithmetic” (tolerance to 3) and “geometric” (ratio is 10) numerical corresponding table

100×1000=100000

0.1	1	10	100	1000	10000	100000
-3	0	3	6	9	12	15

6+9=15

Table4. The “arithmetic” (tolerance to 0.5) and “geometric” (ratio is 10) numerical corresponding table

0.1×1000=100

0.1	1	10	100	1000	10000	100000
-0.5	0	0.5	1	1.5	2	2.5

-0.5+1.5=1

Ask again: why is arithmetic progression of 0 must correspond with geometric sequence 1 better? Don’t they correspond to each other ? At the moment, the teacher not to step in and listen to the students, then, teachers borrow" multiplication and division starting in one, plus or minus starting at 0" in the book“shu li jing yun”which is chese mathematical works to summarize.

Finally, teacher stated Napier (l594-1614) spent twenty years of time, finished with a common ratio of 0.999999 to the table, and the corresponding number named "logarithm" (which means ratio).[2]

2. Consider several dimensions of logistic concept, experience concept through multi-level multi-angle.

Cognition for logarithmic type may be divided into the following seven dimensions: exponential and logarithmic type corresponding relation; identification and pronunciation for logarithmic symbol type; base number; antilogarithm; discrimination of the relationship between logarithmic type of symbol, base number, antilogarithm, and logarithm; An array of count and logarithm for the location of corresponding points in the rectangular coordinate system; alphabetic character significance; relationship of multiplication and addition; contains the operation relations in the indicator of the logarithm that the ancients created.

The teacher dealing with the ways of the last example can be flexible, and the principle is interaction between teacher and students, and perspectives.

For Exponential and logarithmic type conversion: Several solutions exist for teachers and students to complete these transformations as when the teacher presents a formula, students may copy the corresponding formula; or two students may cooperate to create corresponding formulas presenting results, with the teacher adding formulas according to results and the type of need.

B. “PRESENT REASONS” SUPPORTING THE DESIGN IDEA

1. Learning situation analysis and learning difficulty

Log is an integral component of high school compulsory courses. The student’ knowledge reserves about learning the logarithmic: (1) knowledge reserves: high school students have skillfully mastered the operation of addition, subtraction, multiplication, and division, Studied the index and the power of operation, through the study of exponential function, could simply contact actual life, and find the simple application of exponential function in life;(2) ability to reserves: students had been able to realize the unity of opposites, mutual contact and mutual transformation of thought, and mathematical inquiry ability and logical thinking ability get some exercise.

This concept is difficult to understand from the text. First, the logarithmic symbol is difficult to master and often students find the symbol especially trivial and particularly tedious to write; Second, logarithm is the inverse operation of index of operation and as index operation is not thoroughly understood, logarithmic operation is then also a challenge to understand; Third, logarithmic operation is not encountered in daily life, unlike common applications of addition, subtraction, multiplication, division, square root.

The survey revealed common mistakes students make related to the logarithmic concept: ① Logarithmic and exponential type transform each other when the significance of logarithm and antilogarithm are represented by the exchange. Three letters are often placed in positions leading to chaos in the definition of logarithm "$\log_a N = b$"; ②$\log_a N$ is split into multiplication f two numbers ("$\log_a$" and *N)* which is "$\log_a \cdot N$". The error often occurs in operations between several logarithms, the use of this misunderstanding, you may use the distributive law with making addition and subtraction multiplication and division operation between logarithms become addition and subtraction multiplication and division operation between antilogarithms of the logarithms. As granted that $\log_a(m+n) = \log_a m + \log_a n$, the logarithmic arithmetic can make some calculation become simple, visible mindset also plays a role. ③ Do not recognize $\log_2 3$ as the number in the calculation process, thus do not interpret significance of the logarithm. ④ Retain outdated comprehension of logarithm as $\log_a(m+n) = \log_a m \cdot \log_a n$, with the addition and multiplication symbols placed incorrectly, a consequence of ineffective learning.

2. Instructional design dimensions

The teaching design from three dimensions generally considered the historical dimension, logic dimension, cognitive dimension.

From the following three dimensions to the logarithm of the concept of teaching theory structure design .

Cognitive dimensions. An explanation for conceptual difficulty is lack of logarithmic perception. Starting point of cognition, the index concept, reflects points for students to understand as the exponential and logarithmic correspond, acting as the key to understanding logarithmic concept. Multi-level and multi-angle cognizing logarithmic can enhance the understanding of the logarithmic concept.

Logical dimensions. Logarithmic and exponential operations are mutually inverse relationships and the logarithm by definition retains a logical relationship. Based on this, teachers and students cooperate with each other and list the corresponding index and logarithmic type to strengthen understanding for the concepts of logarithmic.

Historical dimensions. Scottish mathematician Napier (Napier1550 ~ 1617) invented logarithm after 20 years of painstaking research. Henry Briggs (Briggs, 1561-1630) visited Napier in 1616 and recommended improvements at base-10 logarithm of the most convenient form, later utilized as common logarithm. Kepler simplified complex calculations of planetary orbits with use of logarithmic tables. Galileo issued rhetoric: "Give me time, space and logarithm, I can create a universe." Mathematician Laplace said: "The logarithm is calculated by shortening the time to make the double life of astronomers." According to circumstances in class found appropriate restructuring history, great men in all things, a timely, let the students from the Angle of history, understand the structure of the logarithm tables rules, understand the role of logarithmic, not only enhance the understanding of the concept of logarithmic, and makes students feel mathematical culture in the study.

The three dimensions above function as abstract summary and offer only guidance to the overall strategy as many researchers mentioned these dimensions in teaching the concept.

Specifically cognize the concept of the logarithm, the author considers again seven dimensions (previously mentioned), by enumerating instances, mutate each dimension to find similarities and differences, multi-level and multi-angle understand logarithmic concept.

3. Use of classical education theory to explain my "present reasons"

1) Historical-Genetic Principle[5]

Historical Genetic Principle states: "The occurrence of individual knowledge follows the process of human knowledge." The idea is applied in mathematics teaching as individual cognitive development and the corresponding mathematics knowledge development process is consistent. Similar barriers exist for today's students as for historical mathematicians regarding the content (inquiry) process and methods for resolving obstacles and solving problems. Teaching design from the logarithm approach for seeking regularity in several forms, guides the student to observe the form, such as one of two lines into arithmetic progression, a line into a geometric sequence. The original idea for constructing logarithm tables to simplify calculations and to be applied as a source of logarithmic invention was as follows: In the geometric row, find two large numbers to form the product. The greater income may be found in the same line. According to the corresponding relationship in the table, the multiplication relationship in one line may be transformed into another row of addition to impart the new lesson, thus utilizing the Historical Genetic Principle.

2) Re-creation of learning theory [6]

Dutch mathematician and mathematics educator Freudenthal (Hans Freudenthal) proposed re-creation of learning theory. He proposed the concept of, axioms, theorems or mathematical language and mathematical symbols in the form of systems, including a variety of algorithms and the need to follow specific steps utilizing the "re-creation" approach to solve the problem. He explained: "' creation ' containing both the content also includes forms, includes new findings and contains the organization. Creation, according to the understanding, is the number of steps in the process of learning, Importance of these steps is emphasis on the word 'again'". Instructional design from the historical perspective as related to teaching logarithm concepts reproduces the original idea of the logarithmic detector where multiplication operations may correspond to addition and the table simplifies the calculation. In the cognitive process of logarithmic concept, teacher and students create corresponding forms of exponential and logarithmic type. The teacher then guides the students to look for the law, strengthening students' understanding of the logarithmic concept providing a concrete application for Re-creation of learning theory.

3) Variation theory

Variation theory is a new exploration and new development of theory for migration, proposed by Sweden educator Ma Feilong (also translated Maarten). Maarten presented his variation theory from the angle of phenomenon graphic and emphasizes that learning is the result of mutations; or learning is to defend oneself; defending oneself depends on the understanding of variation. He pointed out that "teachers should guide students to better understand all aspects of the subject by expanding dimensions of variation" in order to prepare for more final and uncertain variation in the future. Variation theory found and proved that migration is a necessary condition for learning along with commonality and difference. Teaching strategies should be designed to understand key attributes of subjects and to compare variant forms. The teaching mode of "Separation - Variation - Contrast" has been a widely applied practice in many disciplines in both the West and the East.

Showing a few tables in the foreshadowing of this design, although the data of tables is different(this is different), these tables can be found in the common law that have corresponding multiplication and addition(this is common) , especially letting students concern the corresponding 1 and 0 in the tables (common), what are the advantages of these tables? Evaluation for similarities of these tables and tables of logarithm produced by later mathematicians is then feasible. The positive transfer is conducive to learning. With regard to the logarithmic concept, exponential and logarithmic type was different in form. In their corresponding type, the same letter (or number), some names changed, some name didn't change, such as the name of the base unchanged in two corresponding formulas, and the index in the exponential type was said in the logarithmic type, the exponential power was said antilogarithm in the logarithmic type. Showing corresponding names between the two forms By PPT (dynamic), where there are Commonalities and differences. Here starting point of the cognition is exponential type, there are inverse operations in the transformation process of the exponential and logarithmic type, and contrast similarities and differences between the two, which is the process of the defense to strengthen the understanding of the concept. Designed multi-dimensional awareness about logarithmic concept, which involves a large number of instances, there are positive examples and counter-examples. Positive examples and counter-examples confirm each other, and further deepen the understanding of the logarithmic concept.

C. CONCLUSION

Current primary and secondary schools teaching still emphasizes the amount of accumulation and practice. The students do not differentiate between things, and excluding the impact of non-essential factors, and really grasping the essential characteristics, but establishing the concept of strengthening by simple repetition. Comprehension levels then retain potential for much uncertainty as the synthesis and application of knowledge is weak and excessive repetition creates "learning fatigue, " producing the negative effect of student boredom. Improvements to the teaching model should be accomplished through application of educational theory that includes the Historical-genetic-principle, Re-creation of learning theory, and the Variation theory, etc.

No clear boundaries exist between classical education theories and those mentioned above. A cross even exists between the ideological essences of these theories and other local Chinese classical theories. These principles guide teaching practices for specific classrooms and it is difficult parse out one teaching principle as applied on a daily basis. Historical-genetic-principle, Re-creation of learning theory and Variation theory, for example, were utilized simultaneously in the introduction of the design principle. In this paper, it is too absolute for only using the principle of generating history, re-creation of learning theory, and variation theory to explain the intent of this design. I have been taught for more than twenty years, educational thought also marked with the stigma of the changing times, "heuristic teaching", "advance gradually in due order" ,"teach students in accordance with their aptitude", "teacher-led, student-centered", " double subjects ", "pedagogy of variation" "constructivism", "problem solving", "zone of proximal development", "learn by doing", "the migration theory", "focus on the essence, dilute form", "To explore problem", "the research study", " Historical-genetic-principle "," Maarten variation theory "," re-creation of learning theory "," APOS theory "and so on, shine in my mind. The author is not knowledgeable, and dare not say to understand the essence of education thought, but feel this design is affected by many kinds of education thought. The unconscious use of heuristic teaching, pedagogy of variation and other variants of teaching theories in the design indicate that some educational theories have been popular in the majority of teachers groups. Heuristic teaching originated from teacher Confucius and, two thousand years later, the teaching philosophy is not only deeply rooted in the local community but across the oceans. Pedagogy of variation was proposed by Gu Lingyuan and developed in the north and south of homeland, achieved fruitful educational outcomes and attracted the attention of international scholars.

Based on to the ideas of the each educator, author also summed up the strategy of "present reasons" of my own: according to the teaching contents and learning situation analysis, we seek for the existence of difficulties in the learning process of students to find the starting point of cognition for students to understand, and then build bridge and pave road, gradually approach the research question, and multi-level multi-angle Analyze the problem, in order to achieve the purpose of profound understanding.

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