Study on the Construction of a Psycho-Behavioural Model of Rural Teachers' Processing of Knowledge in Classroom Scenarios

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Abstract. In the context of education in the new era, high demands are placed on the professional development of rural teachers. Therefore, this paper uses the content analysis method and strictly follows the steps of its analysis, coding 200 qualitative documents on the relevant topics with the help of NVivo11 software, obtaining 474 free nodes and continuously grouping the free nodes into categories, finally forming 72 tertiary codes, 23 secondary codes and 4 primary codes, and then selecting the secondary codes and primary codes and combining them with the actual classroom teaching in rural areas on The model of the mental behaviour of rural teachers' knowledge processing in classroom scenarios was constructed to help rural teachers improve their ability to teach in the classroom, enhance the acquisition of practical knowledge and promote self-professional development.

Keywords: classroom scenarios; rural teachers; mental behaviour towards knowledge processing; model construction; content analysis approach.

1. Presentation of the problem

With the implementation of the new curriculum standards for basic education in China and the continuous development of the new curriculum reform, modern educational concepts have been penetrated while higher requirements have been put forward for primary and secondary school teachers[1]. In particular, the professional development of rural teachers is also facing greater challenges. For rural teachers, the classroom is the main venue for their professional development. While transforming their professional knowledge into personal knowledge through the real-life context of classroom teaching, rural teachers are constantly interacting with their environment, thus developing practical knowledge. Only when they take a classroom ecological perspective and integrate the classroom ecological factors can they facilitate the transformation of their mental behaviour towards the processing of knowledge in their classroom scenarios. Due to the complexity of classroom ecological factors and the fact that practical knowledge is difficult to control and change, it is currently difficult for rural teachers to describe their own mental behaviour towards knowledge processing in their classroom scenarios in concrete terms.

However, the spread of computers and the development of artificial intelligence technology offer new possibilities for solving this problem. Nowadays, rural schools are basically well equipped with multimedia equipment, and rural teachers can directly record videos of their classroom teaching as well as they can do their daily teaching tasks such as writing lesson plans and reflecting on their teaching on the computer, but it is difficult to apply this data directly. The reason for this is that, on the one hand, there is a lack of psycho-behavioural models of knowledge processing that meet both the laws of education and the needs of rural teachers. Because the data from classroom videos and lesson plans and reflections are unstructured, a prerequisite for the computer to understand them and make dynamic changes is to have an appropriate psycho-behavioural model of knowledge processing for rural teachers.

2. Research Methodology

The content analysis method is a combination of qualitative and quantitative research methods in which the content of the literature is analysed, coded scientifically and the results analysed in depth [2]. Its coding process is carried out with the help of NVivo11 software.

3. Data analysis process based on content analysis method

The content-based analysis approach and followed the analysis process of the method, which was divided into five steps: identification of the research sample, creation of analysis units, construction of categories, coding and identification of elemental entries, and analysis of textual material [7]. The coding was carried out using NVivo11 software to code 200 qualitative documentary materials that fit the research theme. The free nodes formed by the coding are subordinate to each other and the coding can be divided into tertiary, secondary and primary coding according to the hierarchical relationship. The tertiary codes were obtained by integrating the original information points extracted from the literature with similar meanings; the secondary codes were obtained by integrating the tertiary codes with similar meanings again; and the primary codes were obtained by refining the secondary codes and based on a certain theoretical model framework. The bottom-up coding is a more intuitive way to show the relationship between the elements.

3.1 Defining the research sample

The data source for this study was mainly from the CNKI database literature on China Knowledge Network. The CNKI database of China Knowledge Network was accessed and its advanced search function was used to search the literature. As rural and countryside are equivalent, a total of 373 documents were initially searched for SCI-sourced journals, core journals of Peking University and CSSCI journal literature, using rural teachers' professional development and rural teachers' professional development as the subject terms first. As this study was to study rural teachers' professional development from the perspective of classroom ecology, in order to ensure the comprehensiveness of its research data, another search was conducted using classroom ecology as the subject term, supplemented by 172 literature related to the research topic. Thus a total of 545 SCI-source journals, core journals of Peking University and CSSCI journals literature related to the research topic were finally obtained after. To ensure the accuracy of the data, 147 quantitative literature, 200 qualitative literature and 198 literature not related to the subject research were collated. The 200 qualitative literatures were finally identified as the sample for this study and coded using NVivo11 software.

3.2 Create analysis units

Following the analysis process of the content analysis method in establishing the unit of analysis, we have the flexibility to specify a paragraph, phrase or word that expresses a specific meaning in the research sample as being an entry, depending on the type of research sample and the actual needs of the study, after which the process of categorising the entries according to their meaning is coding. As the sample for this study was entirely documentary, the phrase was chosen as the smallest unit of analysis for this study.

3.3 Create a category

There are generally two basic approaches to coding for content analysis methods: the first is to design a relatively easy coding scheme of one's own or to use some currently established theories to code according to the needs of the study; the second is to code based on existing sources. This study is based on 200 qualitative literature sources related to the topic of this study as a coding basis, and the contents of these texts were systematically sorted, dissected in layers, coded and categorised one by one. This can be understood here as adopting and following a bottom-up coding idea, forming a three-level coding - secondary coding - primary coding.

3.4 Coding and elemental entry identification analysis

In order to guarantee the comprehensiveness and accuracy of the content analysis, this study read the full text of the literature for each research sample imported into the NVivo11 software and manually coded it during the reading process using the function of relevant coding in the NVivo11 software, creating free nodes and coding them at the tertiary, secondary and primary levels, merging and grouping them into categories.

3.4.1 Three-level codes

In this study, a sample of 200 pieces of qualitative literature that fit the research topic was imported into NVivo11 software, and each piece of literature was read in full and analysed and coded in detail. The process of reading the literature for manual coding found as many phrases as possible that could influence the mental behaviour of rural teachers' processing of knowledge in classroom scenarios and coded them using the expressions in the original literature, yielding a total of 482 free nodes with a coding frequency of 8687 times.

Eliminating the inconsistent free nodes, this process deleted eight free nodes of moral philosophy, curriculum concept, teaching culture, educational culture, teaching emotion, educational emotion, money and money, with 8 free nodes coded at 0.09% of the frequency. The process of integrating the remaining 474 free nodes will result in many free nodes with similar meanings but different expressions, such as traditional folklore, traditional culture, traditional customs, historical culture, folk art and folk customs, all of which can be classified as traditional customary culture and should be further merged. Merging such similarly meaningful repetitive free nodes yielded 72 categories, with a combined coding frequency of 8,677 times. The three-level coding process is shown in Table 1.

Table 1 Three-level codes

Serial number	Category	Free Nodes	Number of codes	Percentage of
1	Teaching knowledge	Knowledge; pedagogical knowledge; subject knowledge; educational knowledge; pedagogical knowledge	729	8.39%
2	Teaching Reflection	Teaching Reflection; Reflection; Self-reflection; Practice Reflection	551	6.34%
3	Cooperation and exchange	Cooperation; cooperative exchange; cooperative interaction	448	5.16%
4	Teaching Practice	Teaching practice; Educational practice; Educational teaching practice	360	4.14%
5	Local Culture	Vernacular culture; rural knowledge; local culture; rural cultural construction	359	4.13%
6	Teaching Experience	Experience; Teaching experience; Educational experience; Educational teaching experience	347	3.99%
7	Educational Philosophy	Educational Philosophy; Philosophy	285	3.28%
8	Communication	Communication exchange; dialogue exchange; communication; communication interaction	275	3.17%
9	School-based Training	School-based training; school-based teaching and research; school-based research and training	258	2.97%

10	Local knowledge	Local knowledge; vernacular knowledge; indigenous knowledge	255	2.94%
11	Teaching content	Educational teaching content; teaching priorities and difficulties	236	2.72%
12	Education concept	Educational Concepts; Concepts; Educational Teaching Concepts	219	2.52%
13	Teaching Activities	Teaching activities; educational and teaching activities; classroom organization	214	2.46%
14	Classroom Environment	Classroom Environment	213	2.45%
15	Textbook	Textbook; Textbook; Textbook selection	198	2.28%
16	Teaching and Research	Teaching and research, teaching and research activities; teaching and research seminars	194	2.23%
17	eaching Method	Educational teaching methods; teaching methods; methodological guidance	189	2.18%
18	Teaching Resources	Teaching resources; educational resources; multimedia courseware	173	1.99%
19	Self-identification	Identity; professional identity; self-identity	169	1.95%
20	Teaching Context	Teaching Context	166	1.91%
21	Educational Beliefs	Educational beliefs; beliefs	152	1.75%
22	Teaching style	Teaching methods; teaching tools; reception, indoctrination	137	1.58%
23	New Curriculum	New Curriculum; New Course	131	1.51%
24	Values	Values	131	1.51%
25	Teaching Strategies	Teaching Strategies	120	1.38%
26	Teaching Case	Teaching case; case study; lesson example; educational story	117	1.35%
27	Teaching equipment	Teaching equipment; software and hardware; teaching media; teaching facilities	112	1.29%
28	Teaching Research	Teaching research; teaching research; academic salon; thesis and publications	104	1.20%
29	Teaching Objectives	Teaching Objectives; Teaching Objectives	103	1.19%
30	Self Knowledge	Self-knowledge; pedagogical cognition; knowledge structure; individual knowledge	101	1.16%
31	Teaching Theory	Teaching theory; educational theory; educational teaching theory; subject teaching theory	98	1.13%
32	Time and Energy	Time; time and energy	91	1.05%
33	Teaching tasks	Teaching tasks; self-study tutoring; homework review; summary practice	85	0.98%

34	Lesson Plan	Lesson plans; instructional design; writing lesson plans; lesson plan writing; lesson plans; lesson plan teaching	81	0.93%
35	Research	Research; Subjects; Subjects Seminar	78	0.90%
36	Cultural Environment	Cultural environment; human environment; cultural atmosphere; vernacular environment	77	0.89%
37	Collective lesson preparation	Collective lesson planning; lesson planning; shared lesson planning	74	0.85%
38	Traditional customs and culture	Traditional folklore; traditional culture, traditional customs; historical culture; folk art; folk customs; folklore	72	0.83%
39	Interpersonal	Interpersonal communication; way of handling things	68	0.78%
40	Course Resources	Course resources; supporting teaching materials; textbook resources	67	0.77%
41	Teaching behavior	Teaching behavior	66	0.76%
42	Vernacular life experience	Local lived experience; lived experience; vernacular lived experience; rural lived experience	55	0.63%
3	Teaching observation	Teaching observation; learning observation; classroom teaching observation; lesson observation; practical observation	47	0.54%
44	Teaching Ideology	Education and teaching ideas; teaching ideas; educational ideas	46	0.53%
45	Living Environment	Living environment; Working life; Survival situation; Living conditions; Survival environment	46	0.53%
46	Theoretical knowledge	Theoretical knowledge; theoretical knowledge	44	0.51%
47	Seminar	Workshops; Topic workshops; Group workshops; Workshops and sharing	40	0.46%
48	Cultural Identity	Cultural identity; local sentiment; cultural good customs; rural emotion; cultural spirit; local human feelings; cultural observation	40	0.46%
49	Value of Life	Value of life; value of life	40	0.46%
50	Student Knowledge	Student knowledge; student cognitive level; student life experience; knowledge level	37	0.43%
51	Textbook knowledge	Textbook knowledge; Textbook knowledge; Book knowledge; Textbook content	32	0.37%
52	Practical experience	Practical experience; teaching practice experience; educational practice experience	31	0.36%

53	Learning	Learning Situation; Learning Situation Analysis; Interests	29	0.33%
54	Teaching Diary	Teaching diaries; teaching journals; teaching narratives; creating self-analysis profiles	24	0.28%
55	Demonstration of open class teaching	Demonstration class; public class; demonstration teaching; public class teaching	23	0.26%
56	School Culture Building	School culture construction; culture construction; campus culture; school culture; school-level cultural reunion	23	0.26%
57	Cultural Resources	Cultural resources; local resources; vernacular resources; rural-specific cultural resources; vernacular special curriculum resources	22	0.25%
58	Mental stress	Mental stress; stress	21	0.24%
59	Working Environment	Working Environment	20	0.23%
60	Human Care	Humanistic care; caring for life; humanistic connotation	18	0.21%
61	Teaching Style	Teaching style; habits of mind	17	0.20%
62	First-hand experience	Hands-on experience; hands-on practice; self-experience; hands-on participation; hands-on experience	17	0.20%
63	Teaching Videos	Teaching videos; classroom videos; instructional videos	15	0.17%
64	Teaching materials	Teaching materials; teaching reference materials; reference books; teachers' books	15	0.17%
65	Educational Values	Educational Values; Educational Perspectives	14	0.16%
66	Life Experience	Living practices; living habits; productive life; lifestyle	14	0.16%
67	Local materials	Local materials	12	0.14%
68	Teaching Model	Teaching mode; Classroom teaching mode; Educational teaching mode	12	0.14%
69	Teaching and learning decisions	Instructional Decision Making; Decision Making	9	0.10%
70	Resource allocation	Resource allocation	5	0.06%
71	Syllabus	Syllabus; Syllabus; Examination content	4	0.05%
72	Teaching programs	Instructional programs; instructional program design	2	0.02%

3.4.2 Secondary Codes

The categories of the free nodes obtained from the tertiary coding are fragmented and the correlations between them are not yet visible. For this reason, the separate free node categories are linked together and reduced to the categories of the secondary codes. The function of the secondary codes is to bring together the concepts named in the tertiary codes and to find the relationships between the secondary coded categories. As resources are essential for teaching in rural teachers'

classrooms, the categories related to resources in the tertiary codes were retained, and the 72 tertiary codes were grouped into 23 secondary codes, as shown in Table 2.

Table 2 Secondary codes

Serial number	Category	Secondary codes of coding categories
1	Interpersonal knowledge	Interpersonal interaction; cooperative communication; communication.
2	Textbook knowledge	Teaching materials; knowledge of teaching materials; new standards; syllabus.
3	Local knowledge	Vernacular culture; vernacular knowledge; cultural environment; vernacular life experience; cultural identity; vernacular materials; traditional custom culture; cultural resources; school culture construction
4	Teaching knowledge	Teaching knowledge; Teaching content; Teaching objectives
5	Cognitive Resources	Teaching experience; teaching activities; time and energy; mental stress; living environment; working environment; practical experience; teaching tasks
6	Critically reflect on knowledge	Teaching diary; teaching research; project research; school-based training
7	Teaching and Research	Teaching and research; seminar; teaching observation; demonstration of public class teaching; group lesson preparation
8	Teaching Resources	Teaching resources; teaching equipment; curriculum resources; teaching materials; resource allocation; teaching programs
9	Educational Beliefs	Educational beliefs; educational concepts; educational philosophy
10	Self Knowledge	Self-identity; self-knowledge; life values; personal experiences; life experiences; teaching style
11	Lesson Plan	Lesson Plan
12	Situational knowledge	Classroom Environment; Teaching Context
13	Educational Values	Values; educational values; humanistic care
14	Teaching implementation	Teaching Practice
15	Strategy Selection	Teaching Strategies
16	Video of classroom teaching	Teaching Videos
17	Teaching Theory	Teaching theory; theoretical knowledge; teaching ideas
18	Strategic Knowledge	Teaching methods; teaching styles; teaching models
19	Teaching Case	Teaching Case
20	Teaching Reflection	Teaching Reflection
21	Student Knowledge	Student knowledge; learning
22	Teaching behavior	Teaching behavior
23	Teaching and learning decisions	Teaching and learning decisions

3.4.3 Level one Codes

This session refines the primary coding categories through the secondary coding categories. Classroom teaching for rural teachers is essentially a process of knowledge transfer between teachers and students. The rural teacher's ability to process knowledge largely determines the effectiveness of the lesson and the degree of self-practice knowledge gained, in relation to the process of knowledge transformation and processing in real classroom teaching. Therefore, the 23 secondary coding categories should be further refined and summarised, and eventually four primary coding categories, namely knowledge preparation, knowledge perception, knowledge transmission and knowledge preservation, were obtained, as shown in Table 3.

Table 3 Level one codes

Serial number	Level one codes	Category
1	Knowledge preparation	Teaching resources; pedagogical knowledge; student knowledge; textbook knowledge; vernacular knowledge
2	Knowledge Awareness	Cognitive resources; teaching theory; teaching examples; strategic knowledge; self-knowledge; strategy choice; teaching decisions; critical reflective knowledge; contextual knowledge; educational beliefs; teaching values; teaching behaviours
3	Knowledge dissemination	Teaching implementation; interpersonal knowledge; Teaching and Research
4	Knowledge Preservation	Lesson plans; classroom videos; teaching reflections

4. Reliability test

4.1 Credibility test

In order to make the results of the study more objective and reliable, it is necessary to test the reliability of the study using content analysis. The reliability of content analysis refers to the degree of agreement between two or more coders in judging the same data. The author of this study acted as coder A and another current graduate student familiar with content analysis and the NVivo11 software was selected as coder B. Prior to coding the two coders discussed in depth the framework of the study's analysis and the rules of coding, and on the basis of gaining a consistent understanding, a random sample of documents from this study will be recoded to test their reliability. As it is now widely used in the academic community, a sample of 10-25% of the total population is selected for reliability testing [8]. In this study, the sample was selected by searching for the terms "rural or rural teachers' professional development" and "classroom ecology". Therefore, when conducting the reliability test, 27 papers on "rural or rural teachers' professional development" and 18 papers on "classroom ecology" were randomly selected, making a total of 42 papers in the sample, which accounted for 21% of the sample. This proportion meets the requirements of the sample, and it is reasonable to use it as the sample for the reliability test. The latter two coders recoded the 42 randomly selected documents and categorised the results to obtain mutual agreement and reliability using the Holsti formula [9]. In this case, the mutual agreement was calculated to be 0.81 and the reliability was 0.90. Holsti believes that research findings with a reliability above 0.80 are valid, and the reliability of this study was 0.90, which exceeded 0.80, indicating that the findings of this study are reliable and acceptable.

4.2 Validity test

The validity of content analysis is usually referred to within the academic community as a measure of the objective empirical validity and value of a concept. In the case of this study, which is based on content analysis, the 200 selected qualitative literature texts are to be analysed for content validity.

Firstly, the research sample for this study was derived from SCI source journals, Peking University core journals and CSSCI journal literature, which are all core journals and reliable data sources. The researcher also communicated with the instructor and the coder several times to ensure the validity of the coding. Thirdly, the coding can be used to understand the mental behaviour of rural teachers in processing knowledge in classroom situations, which is of practical guidance and value in helping rural teachers to improve their classroom teaching skills. The manual coding of the research sample in the NVivo11 software overcame to some extent the problem of subjectivity of individuals determining the categories for analysis. Therefore, this study is considered to have sufficient validity.

5. Construction and interpretation of a model of rural teachers' mental behaviour towards knowledge processing in classroom scenarios

By using the content analysis approach, the research was carried out in strict accordance with the steps of the content analysis method: identifying the research question, determining the research sample, establishing the unit of analysis, establishing the category, coding and elemental entry identification analysis, and reliability testing. By coding and analysing 200 qualitative literature sources, a model was constructed for analysing rural teachers' mental behaviour towards knowledge processing in simulated classroom scenarios (see Figure 1), and it passed the reliability and validity tests. Information processing theory in cognitive psychology is usually regarded as an information processing system that sequentially receives, stores, processes and transmits information [10]. This corresponds to the actual classroom scenario in which rural teachers process knowledge in stages: knowledge preparation, knowledge perception, knowledge transmission and knowledge retention. These four stages also correspond to the first level of coding formed by coding 200 pieces of qualitative literature in a continuous process of categorisation. In this way, the complete process of knowledge processing by rural teachers in the classroom scenario can be divided into a total of four stages: knowledge preparation, knowledge perception, knowledge dissemination and knowledge preservation, which is easy to understand.

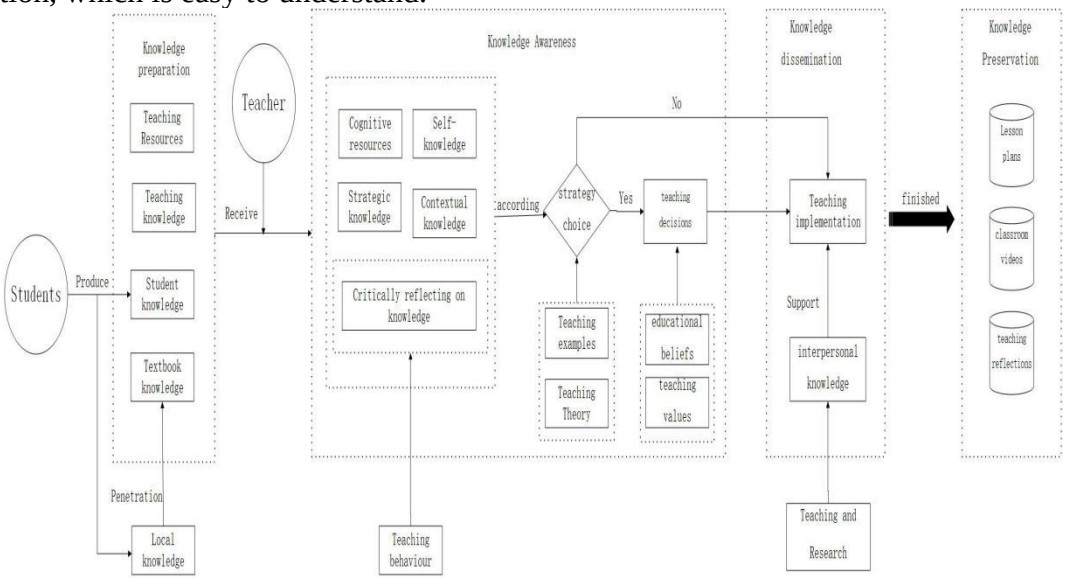

Figure 1 Mental-behavioural model of rural teachers' processing of knowledge in classroom scenarios

5.1 Knowledge preparation

By entering the classrooms of IT, Mathematics and English in rural schools, it is easy to see that in the classroom scenarios, most rural teachers make use of electronic whiteboards and teach according to the lesson plans and corresponding curriculum resources they have written, while rural teachers take into account the students' previous knowledge base and the rural knowledge they have generated in the actual rural life or environment, and they further infuse the students' They also take

into account the students' previous knowledge base and the rural knowledge they have generated in their actual rural life or environment, and they further infuse the rural knowledge generated by the students into the materials so that the students can better understand the materials. In a post-lesson exchange with the rural teachers, they talked about how they focused more on the teaching objectives to refine the knowledge they were trying to impart in the classroom, while at the same time focusing on the knowledge they were imparting. Therefore, in the knowledge preparation stage, it is clear that the knowledge that rural teachers have to deal with in classroom scenarios is: pedagogical knowledge, teaching resources, student knowledge, textbook knowledge and rural knowledge. The essence of resources is also a kind of knowledge, so there is no ambiguity and it is reasonable to see teaching resources here as the knowledge that rural teachers are prepared to cognise.

5.2 Knowledge Awareness

In order for rural teachers to better implement their teaching and improve the acquisition of practical knowledge, thus improving their classroom teaching skills and promoting their self-professional development, they need to have a concrete understanding of their psychological behavioural processes of processing knowledge in classroom scenarios. The knowledge awareness stage is equivalent to the brain of the rural teacher. When rural teachers know exactly what knowledge they want to know in the knowledge preparation stage and receive this knowledge, they mentally choose their strategies based on self-knowledge, cognitive resources, contextual knowledge, strategic knowledge and critical reflection knowledge. The self-knowledge includes self-identification, self-life experience, and knowledge of self-instructional style; cognitive resources include accumulated teaching experience, teaching activities to be organised, and time and energy; situational knowledge includes the rural teachers' perception of the specific classroom environment and teaching situation, and their corresponding teaching strategies; strategic knowledge is often reflected through the adoption of teaching methods, teaching solutions, and teaching approaches; and critical reflective knowledge. Strategic knowledge is often expressed through the adoption of teaching methods, teaching solutions and teaching approaches; critical reflective knowledge is generally accumulated by rural teachers through reflection on their own teaching behaviour. When choosing strategies, rural teachers take into account their own knowledge, cognitive resources, interpersonal knowledge, situational knowledge, strategic knowledge and critical reflection knowledge. At the same time, rural teachers' own long-accumulated teaching theories and teaching cases formed after practising classroom teaching have a certain influence on their strategy choices. When rural teachers make strategy choices, they make instructional decisions, and when they do not, they do not. The teachers' own educational values and beliefs guide them in their decision making.

5.3 Knowledge dissemination

In the knowledge transfer phase, which is mainly described as the implementation of teaching and learning by rural teachers, this is a key step in the transformation of knowledge. Whether or not this stage can be successfully completed depends on whether or not the teacher has made a choice of strategy in the previous stage. How the choice of strategy is made will lead to teaching decisions accordingly, and the teacher will implement the teaching and smoothly transmit knowledge, and vice versa cannot successfully achieve knowledge transmission. And rural teachers constantly collaborate and communicate with others from demonstrations of public lessons, group lesson preparation, project research and other teaching and research, gaining interpersonal knowledge of classroom management, how to control the classroom and mobilise the classroom atmosphere to support them in the smooth implementation of teaching and learning.

5.4 Knowledge preservation

According to the psycho-behavioural model of knowledge processing by rural teachers, the stages of knowledge preparation, knowledge perception and knowledge transmission are followed by the preservation of knowledge. Knowledge is usually preserved in the form of lesson plans, video

recordings of classroom teaching and reflections. The data from these saved knowledge types are integrated and can be used to create multiple examples that can be used as a guide for classroom teaching.

6. Summary

This study constructs a model of rural teachers' mental behaviour towards knowledge processing in classroom scenarios through a content analysis method with the help of NVivo11 software coding, which is an important inspiration for promoting rural teachers' self-professional development. Rural teachers should clarify the knowledge they have to process in classroom scenarios, make strategic choices when processing knowledge that are highly integrated with their knowledge of teaching practice, make correct teaching decisions and complete the dissemination of classroom knowledge, and then integrate the saved knowledge type data to form personalised cases to further promote self-professional development.

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