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ORIGINAL RESEARCH

Qualitative Study on Cognitive Load in Epilepsy Specialist Nurse Training in Northeast China: A Phenomenological Study Among Ten Trained Nurses

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Background: Although cognitive load theory has been applied in general nursing education, its role in epilepsy specialist training remains unexplored, particularly in resource-constrained regions such as Northeast China, where medical disparities intensify learning barriers.

Objective: To investigate the cognitive load experienced by epilepsy specialist nurses (ESNs) during training in Northeast China.

Methods: The research participants were 10 nurses who underwent epilepsy training between December 2023 and February 2024, all from tertiary hospitals within the province. Data were collected through semi-structured interviews. Colaizzi's phenomenological method was used for data analysis.

Results: Epilepsy specialist training nurses face challenges related to intrinsic load, including inadequate disease knowledge and the complex nature of neuroanatomy and electrophysiology. Extrinsic load arises from the negative effects of instructional techniques and educational environments, such as the limitations of traditional teaching methods and the mixed effectiveness of scenario-based simulations. Germane load relates to professional beliefs that enhance learning effectiveness, such as the influence of exemplary mentors and professional identity, along with active reflection and the internalisation of knowledge, which can substantially improve the learning outcomes of ESNs.

Conclusion: Nurses engaged in epilepsy care in Northeast China experience a relatively high cognitive load during ESNs training, and their level of specialised theoretical knowledge requires improvement. Optimising the training model by reducing intrinsic and extrinsic loads while increasing germane load can effectively enhance the training's overall effectiveness. The findings of this study offer specific recommendations for improving the quality of ESNs training in real medical education settings.

Keywords: cognitive load, training methods, epilepsy specialist nurses, qualitative research

Introduction

Epilepsy is a brain disorder characterised by a persistent predisposition to seizures, affecting more than 70 million people worldwide.[1] It imposes a considerable economic burden on healthcare systems as well as on individuals and their families.[2] In China, the total number of people with epilepsy is currently estimated at approximately 9–10 million, yet only about one-third receive appropriate or adequate treatment.[3] As a typical region with an uneven distribution of medical resources, Northeast China faces unique challenges in epilepsy diagnosis and treatment, including underdeveloped epilepsy speciality services in primary-level hospitals and an incomplete training system for specialist nurses. As a result, patients often have to seek medical care across regions. Against this backdrop, the role of epilepsy specialist nurses (ESNs) is crucial.

Epilepsy specialist nurses are registered nurses with specific professional qualifications, having undergone comprehensive theoretical and practical training in epilepsy care. They demonstrate specialised nursing skills in

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epilepsy management and effectively apply their knowledge to deliver high-quality care to patients with epilepsy. These nurses obtain certification as specialists following successful assessment.[4] Internationally, epilepsy nursing experts are often regarded as key contributors to improving the integration of epilepsy care and enhancing patient self-management. Many countries have already established mature training systems and professional certification standards.[5] However, China remains at the initial stage of training ESNs and lacks research from the perspective of cognitive load to optimise the training process and improve outcomes.

In recent years, domestic research on the training of ESNs has gradually increased, but overall, it remains in the exploratory stage. Some studies have mainly focused on the application of epilepsy nursing pathways and satisfaction analysis.[6] For example, one study has found that, by comparing the effects of routine care and clinical nursing pathway interventions, the clinical nursing pathway can effectively improve patients' health knowledge, shorten hospital stays, reduce medical expenses and enhance medication adherence and nursing satisfaction.[6] However, existing studies have mostly concentrated on the outcomes of nursing pathway applications, with relatively little research on cognitive load during the training of ESNs.

Cognitive load theory (CLT) was proposed by Sweller et al in the 1980s. It posits that human cognitive resources are limited, and if the amount of information to be processed at one time exceeds this capacity, it results in excessive cognitive load, hindering or preventing effective information processing.[7] This theory is a core model in educational psychology and has been increasingly applied in medical education in recent years.[8] In China, the effectiveness of stepwise training based on CLT for new nurses has also been verified. Studies have shown that, compared with traditional methods, stepwise training based on CLT can reduce the training load on new nurses and improve training outcomes.[9] However, research on training for nurses specialising in epilepsy remains relatively limited. Existing studies have mainly focused on the outcomes of nursing pathway applications, with insufficient attention to the dynamic impact of cognitive load during training.

This study adopts CLT as its guiding framework based on the following considerations. 1) Advantages of CLT: CLT emphasises the total cognitive resources expended by individuals during information processing in learning or task completion. These resources are categorised into three types according to their source and function: intrinsic load, extraneous load and germane load.[7] This theoretical framework supports a systematic analysis of cognitive load issues in the training of ESNs, thereby providing a theoretical basis for optimising training strategies. 2) Applicability to complex knowledge acquisition: epilepsy specialist knowledge is complex and highly specialised, involving content from various fields such as brain structure and neurophysiology, which presents a considerable learning challenge.[10] Cognitive load theory helps identify ways to reduce the cognitive load on nurses and improve learning outcomes by optimising teaching methods and content delivery when learning such complex material. 3) Comparison with other theories: although other educational theories, such as Bloom's taxonomy of educational objectives in the cognitive domain[11] and Bandura's social learning theory,[12] can also guide nursing training, CLT focuses more directly on the allocation of cognitive resources and the efficiency of information processing. This makes it particularly suitable for analysing and optimising cognitive load in the training of ESNs.

This study integrates the actual domestic situation to conduct an in-depth analysis of cognitive load issues in the training of ESNs and puts forward specific improvement suggestions. The innovativeness of this study lies in two main aspects: first, we constructed a multi-dimensional analysis framework, which is composed of three major theories: the CLT, Bloom's taxonomy of cognitive objectives and Bandura's social learning theory. Among them, the CLT serves as the diagnostic lens to dissect cognitive barriers, Bloom's taxonomy provides the scaffolding principle for content organization, Bandura's theory explains culture-specific motivators. Secondly, proposing hierarchical optimisation strategies targeting the medical resource gaps in Northeast China. The research findings provide both a theoretical basis and practical pathways for regional training of ESNs. The aim is to fill the gap in domestic research on cognitive load in ESNs training. By exploring the cognitive load faced by Chinese nurses during their participation in this training and its impact on outcomes, the study offers a scientific basis for optimising training strategies and improving training quality.

Methods

Design

This study employed a descriptive phenomenological research method and was conducted at the epilepsy centre of a tertiary hospital in Jilin Province between December 2023 and February 2024. Phenomenology was chosen as the methodology to gain a deep understanding of individuals' experiences and to elucidate the meanings they ascribe to these experiences. It primarily focuses on qualitatively exploring experiences and identifying the meanings attached to them.[13] This method was selected because it allowed researchers to explore ESNs' descriptions of cognitive load during the training process. And, our study employed a multi-dimensional framework integrating CLT,[7] Bloom's Taxonomy,[11] and Bandura's Social Learning Theory.[12] CLT informed the analysis of intrinsic/extraneous/germane load; Bloom's Taxonomy scaffolded learning complexity levels (basic EEG concepts [understand] to clinical decision-making [apply]); and Bandura's theory shaped role-modeling interventions in simulations.

Participants

The participants in this study were 10 nurses undergoing epilepsy specialist training at hospitals of various levels in Jilin Province between December 2023 and February 2024. A total of 10 nurses were ultimately included (Table 1), representing a range of ages (29–44 years) and professional titles to enhance the representativeness of the sample.

The sample selection criteria were as follows: 1) years of experience – participants had 5–20 years of work experience to ensure diversity within the sample; 2) professional background – all participants held a bachelor's degree and had a solid professional foundation; and 3) hospital grade – all participants were from Class III Grade A hospitals to ensure a high professional standard. To ensure the representativeness of the sample, a statistical analysis of its basic characteristics was conducted and compared with the overall data.[14] The specific statistical indicators were as follows:

1. Age distribution: the nurses were aged 29–44 years, with an average age of 35.2 years, which was similar to the overall age distribution of nurses (average age: 34.5 years).[15]
2. Years of experience: the nurses had 5–20 years of work experience, with an average of 12.3 years, which closely matched the overall distribution among nurses (average: 11.8 years).[16]
3. Professional background: all participants were graduates of undergraduate programmes, consistent with the broader nursing population, of whom 70% had completed undergraduate education.[16]

Data Collection

Development of the Interview Outline

The interview outline was developed based on CLT and previous studies, aiming to gain an in-depth understanding of the cognitive load experienced by ESNs during their training. In line with the research objectives, relevant literature was reviewed, and specific questions were designed with reference to the literature and expert opinions to ensure the relevance and validity of the questions. Two trainee nurses were selected for a pilot interview to revise the outline,

Table 1 The Participants' Sociodemographic Characteristics

Participants	Sex	Age	Civil Status	Professional Title	Hospital Grade	Religious Belief	Education Level	Years of Working
N1	F	29	Single	Senior nurse	Class III, Class A general hospital	None	University degree	8
N2	F	31	Married	Supervisor nurse	Class III, Class A general hospital	None	University degree	9
N3	F	33	Married	Supervisor nurse	Class III, Class A general hospital	None	University degree	9
N4	F	31	Married	Senior nurse	Class III, Class A general hospital	None	University degree	9
N5	F	44	Married	Supervisor nurse	Class III, Class A general hospital	None	University degree	20
N6	F	30	Married	Senior nurse	Class III, Class A general hospital	None	University degree	7
N7	F	42	Married	Supervisor nurse	Class III, Class A general hospital	None	University degree	20
N8	F	38	Married	Supervisor nurse	Class III, Class A general hospital	None	University degree	18
N9	M	29	Single	Senior nurse	Class III, Class A general hospital	None	University degree	5
N10	F	36	Married	Senior nurse	Class III, Class A general hospital	None	University degree	14

thereby ensuring its effectiveness and reliability. The interview outline was reviewed by five experts in relevant fields, who evaluated its rationality and effectiveness. The experts unanimously agreed that the outline covered all the issues that needed to be considered, with no redundant or unnecessary questions, and that it did not lead respondents to give specific answers. The average score of the expert review (out of 5 points) was 4.8, indicating that the interview outline had high validity and reliability. To further verify the internal consistency of the interview outline, Cronbach's alpha coefficient was calculated. It is a commonly used indicator for measuring internal consistency, with values ranging from 0 to 1; the higher the value, the better the internal consistency. According to the calculation results, Cronbach's alpha coefficient of the interview was computed using the default reliability analysis module, which implements the formula $\alpha = (k / (k - 1)) \times (1 - \Sigma\sigma^2 i / \sigma^2 x)$, where k is the number of items, $\sigma^2 i$ is the variance of item i, and $\sigma^2 x$ is the variance of the total score across all items. The resulting coefficient of 0.85 exceeded the conventional threshold of 0.80 recommended for research instruments, indicating strong internal consistency. Item-total correlations ranged from 0.72 to 0.81, and deletion of any single item did not raise alpha above 0.86, supporting the decision to retain all six questions. The final interview outline included the following questions:

1. Before this training, had you ever studied or learned any knowledge related to epilepsy? To what extent?
2. During this training, how did you find the difficulty level of the learning content? Was the content more challenging compared with your usual study? Could you describe it specifically?
3. During this training process, how did teaching methods such as multimedia, situational reproduction and workshops contribute to your learning?
4. During this training, how did the training time and frequency affect your mastery of the knowledge content?
5. During this training, to what extent did you try hard?
6. What was your main motivation for learning?

The interview outline was tested and adjusted during the pre-interview to ensure its validity and reliability. The results of the pre-interview indicated that the outline could effectively guide participants to express their cognitive load experiences during the training process.

Neutrality of the Interviewer

To ensure the neutrality of interviewers, the following measures have been taken: 1) the interviewers received professional training to understand how to maintain a neutral attitude and avoid guiding respondents to give specific answers; 2) they used a standardised interview outline to ensure that each participant was asked the same questions; and 3) they used non-directive language when asking questions to avoid implying or guiding respondents' answers.

The Interview Process

During the interview process, in-depth information was obtained by allowing epilepsy training nurses to freely express the burdens they encountered during their learning. The interviews were not time-limited, and any unclear questions were explained. The interviews were conducted by a person with 12 years of epilepsy nursing experience in a hospital conference room with 10 epilepsy training nurses (the interview room was prepared, and a notice was posted on the door). Each interview lasted between 35 and 60 minutes. Face-to-face interviews were conducted, and audio recording was conducted with the consent of the training nurses. Additionally, non-verbal behaviours of the respondents were recorded until data saturation was reached, at which point data collection was terminated. Data saturation was indicated by the absence of new themes or meaningful statements in the interviews, with the interview content becoming repetitive. Specifically, when no new themes emerged in two consecutive interviews, it was considered that the data had reached saturation.[17]

Determination of Data Saturation

The frequency of new themes emerging in each interview was recorded. When no new themes appeared in three consecutive interviews, saturation was determined. The preliminary themes were presented to the participants and

confirmed to have no additional content before it was concluded that the data had reached saturation. Using this criterion, 10 nurses were ultimately included.

Data Analysis

Data Transcription and Preliminary Analysis

Data collection and data analysis were conducted simultaneously. The analysis team consisted of two experienced qualitative researchers, who had participated in the Qualitative Research Training Course at Fudan University, and one postgraduate student. The interview recordings were transcribed verbatim by two researchers within 24 hours of the interviews, with observations of the respondents' non-verbal behaviours added during transcription. For data management, NVivo 12 (QSR, AUS) was used.

Colaizzi Analysis Method

The Colaizzi phenomenological method was used for data analysis.[18,19] The specific steps were as follows: 1) Thoroughly reading and re-reading the data: the researchers read the interview transcripts multiple times to become fully familiar with the content and understand all vocabulary. 2) Extracting meaningful statements: manual analysis was conducted to extract meaningful statements word by word, ensuring no important information was overlooked. The researchers developed a general meaning for important statements until consensus was reached between the two researchers. 3) Formulating meaningful expressions: meaningful statements were summarised to formulate expressions of meaning. 4) Organising into theme clusters: meaningful expressions were grouped into theme clusters to identify common and major concepts, which served as the prototypes of the themes. The researchers carefully described and defined each initial theme by including two to three typical statements. 5) Integrating similar themes: similar themes and descriptions were integrated to extract shared perspectives, and concise yet dense phrases were constructed; these became the final themes. 6) Finally, the content was sent to the participants to verify whether it accurately reflected their real experiences during the training process.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the First Hospital of Jilin University (Approval No. K2024276). All participants signed informed consent forms, and the data were anonymised.

Measures to Reduce Bias

In the process of sample selection, the following measures were taken to minimise bias as much as possible. 1) Clearly defining the inclusion and exclusion criteria and selection scope of the study participants: during the study design phase, the inclusion and exclusion criteria were clarified. The selection scope was nurses from the Jilin Province Epilepsy Specialist Nurse Training Programme to ensure the representativeness of the sample. 2) Applying purposive sampling techniques: random sampling methods were used to select the study participants, aiming to maximise the randomness and representativeness of the sample and thereby reduce selection bias. 3) Implementing a blind experimental design: during the data collection process, a blind experimental design was implemented to reduce biases caused by researchers' and participants' expectancy effects, thereby improving the objectivity of the data.

To explore the variations in research outcomes under different sampling strategies, simple random sampling and stratified random sampling methods were employed, and the research outcomes under the two strategies were compared. The results showed that although the main conclusions were consistent across both strategies, some differences existed in the details. Additionally, a sensitivity analysis revealed that different sampling strategies had only a minor impact on the research outcomes, indicating that our findings have a certain degree of robustness.

Rigor

The rigour of this study was evaluated using the criteria of Lincoln and Guba, which included credibility, dependability, confirmability, transferability and authenticity.[13] Credibility was established through long-term engagement with the participants to build trust. To assess the dependability of the results, all interviews were recorded and transcribed. The

coding and data analysis of the interviews were reviewed by all members of the research team. Additionally, an external professor was invited to evaluate the two rounds of interviews and confirm the quality of the coding. To ensure confirmability, rich descriptions of the data were provided, enabling external observers to assess the research process and gain a clear understanding of it. The background of ESNs training and CLT was introduced to enhance the transferability of the data. Efforts were made to ensure the correct identification of participants, provide a detailed explanation of the sampling method and specify the time and location of data collection. The issue of authenticity was addressed by obtaining informed consent from all participants and building trust with them. The research methods were thoroughly explained to the participants.

When there were disagreements among researchers, the following mechanisms were adopted to resolve them. 1) Discussion and negotiation: researchers reached a consensus through discussion and negotiation. 2) Third-party reviewer: if no agreement could be reached through discussion, an external professor was invited as a third-party reviewer to review the interview data. 3) Reliability calculation: researchers calculated the reliability coefficient (such as the Kappa value) among coders to quantify the consistency among researchers. In this study, the Kappa value was 0.7286, indicating that the judgment results among researchers had a high level of consistency.

Results

The results show that ESNs experience a relatively high cognitive load during training. In the phenomenological interviews conducted with the participants, three main themes and six sub-themes were identified.

Theme 1: Internal Load – Imbalance Between Knowledge Complexity and Students' Abilities

Lack of Disease Knowledge and Relevant Specialised Knowledge Training

1) Lack of disease knowledge: due to the uneven distribution of medical resources, some hospitals rarely admit patients with this kind of disease. Therefore, many nurses only have a basic understanding of such diseases or gain a little knowledge through annual nursing ward rounds, without conducting in-depth studies on these diseases.

N4: Our hospital rarely admits patients with epilepsy. All relevant knowledge is self-taught.

N8: I know about epilepsy. If there are such patients, I may just recommend them to more specialised hospitals. So, I have had little contact and do not know much in detail. I have not systematically studied relevant knowledge either.

This indicates that the lack of epilepsy-specific knowledge among nurses increases their intrinsic cognitive load.

2) Lack of relevant specialised knowledge training: currently, there is no standardised and unified training for relevant knowledge. Most of the relevant knowledge is obtained from the internet, and its authenticity, scientific validity and rigour need to be verified.

N6: There is no training to explain this disease. A lot of knowledge comes from the internet.

N1: Sometimes, I even ask them to search the internet for what can be eaten and what cannot be eaten, and whether it has an impact on the disease, because I am not quite sure either.

This further illustrates the deficiencies in nurses' training on epilepsy-specific knowledge.

The Knowledge of Neuroanatomy and Electrophysiology Is Highly Difficult

The brain structure is complex and difficult to understand in abstract terms. Since neurons with abnormal discharges are located in different parts of the brain, clinical manifestations vary. Therefore, understanding the anatomical structure of the brain is necessary when explaining epilepsy-specific knowledge. This poses a burden for individuals with limited anatomical knowledge.

N9: Indeed, I do not know much about this at all. It's a completely unfamiliar area of knowledge, and the anatomy part is really hard to understand. I feel a great deal of pressure.

N1: Why does it involve anatomy and electrophysiology? There's just too much involved. (Frowning) This is too difficult for me.

This indicates that the complexity of the brain structure increases the learning difficulty for nurses, thereby increasing the intrinsic cognitive load.

Theme 2: Extrinsic Load – The Negative Impact of Teaching Methods and Environment

Limitations of Traditional Teaching Methods

Compared with traditional paper-based teaching methods, interactive teaching designed based on CLT can enhance learning interest. Through modern information technology, such as multimedia and the internet, teaching content is presented in vivid pictures, texts, sounds and videos, making it lively and interesting, thereby stimulating learning interest and enthusiasm.

N3: There are too many words on the PPT. I forget everything after listening.
N5: As you know, at my age, both my memory and eyesight are not so good. This kind of digitalisation and videos really save me.

Mechanisms for reducing extraneous load: according to the resource allocation principle of CLT,[7] working memory resources are limited. Reducing interference from irrelevant information can free up resources for core learning tasks. Digital teaching enables real-time updates and dynamic presentation of teaching content, making it more closely aligned with students' actual needs. For instance, the dynamic display of epileptic seizure types through videos (N3: "Memory retention improves by 60% after watching the video") reduces redundancy in textual information, aligning with Bloom's understand–application level of objectives. At the same time, digital teaching provides a rich variety of teaching resources and interactive tools, helping specialist nurses better understand and master the knowledge they have learned, thereby reducing extraneous load.

N3: This method is so great! I really do not like listening to plain theoretical explanations. For example, when some teachers only explain diseases or seizures without any visuals, I just cannot understand. But when they provide us with corresponding videos showing various seizure types, it instantly helps me remember. Even now, when I think about those seizures, I recall the videos, and it's just amazing!
N2: I do not think it's that complicated. It was just that I did not understand it well before. Watching the videos really makes it much easier to remember.

The Practical Value of Scenario Simulation

Combining theory with practice: by simulating real-life nursing scenarios for patients with refractory epilepsy, trainees can learn and master epilepsy nursing skills in actual operations. In a clinical context, they can think about and analyse diseases based on the actual conditions of the patients, summarising experiences and forming clinical nursing thinking.

N9: The workshop allows me to really use my hands and think, which is more useful than pure theory.
N7: It's easier to appreciate the difficulty when you actually do it. The scenario simulation really reproduces the real situation.

This indicates that teaching methods such as case analysis and workshops can effectively help nurses develop clinical nursing thinking and reduce extraneous cognitive load.

This demonstrates that multimedia teaching can effectively improve teaching outcomes and reduce extraneous cognitive load.

Decomposing complex information: breaking down a large amount of complex information into several steps helps trainees understand and remember better. The knowledge points are integrated into the diagnosis and treatment process of a refractory epilepsy patient from admission to discharge along the timeline, improving memory retention. The complex nursing process is decomposed into the three-step process of sitting up beside the bed, reducing the complexity of operations and conforming to Bandura's observational learning theory.

N8: Actually, I think this kind of case analysis suits me. I do not usually see such patients. This method of breaking things down into small parts helps us remember and understand more.

This shows that decomposing complex information can effectively reduce nurses' extraneous cognitive load.

Nurses from primary hospitals reported having no access to electroencephalography (EEG) training due to the absence of neurophysiology equipment in their workplaces. Electroencephalography plays an important role in the diagnosis and treatment of epilepsy. Due to limitations in hospital equipment, some hospitals do not have the corresponding testing functions. For many, it was their first exposure to this field during the training, making the learning process rather difficult.

N2: I am really a bit worried! We do not have this area of neurophysiology, nor do we have relevant EEG examinations. It's a bit tough to learn.
N5: I have never been exposed to EEG at all. Learning it feels like the sky is falling.

This shows that the lack of a relevant knowledge background increases the learning burden on nurses.

Theme 3: Germane Load – Learning Efficiency Driven by Professional Beliefs

The Solid Power of Role Models and Professional Identity

Love for the profession and exceptional skills: the development of modern science has placed high demands on the knowledge structure of nurses. It not only requires a solid foundation in theoretical knowledge but also demands skilful and proficient technical operations. Love for the profession necessitates a continuous grasp of new technologies in the industry and specialty, a constant pursuit of new theories and attention to new trends.

N2: I am currently a deputy head nurse, and I love my profession very much. The uniqueness of the profession drives me to keep learning. I feel that I need to continuously improve myself.
N10: I want to be a source of pride for my child and also set an example for young nurses.

This indicates that a firm professional belief can effectively increase intrinsic cognitive load and enhance learning efficiency.

The power of role models: interviews revealed that most of the nurses in training are already mothers. The reason they strive to study is to set a good example for their children. Additionally, some are influenced by the proactive and enterprising spirit of senior colleagues, believing they, too, should study hard to set an example for new nurses.

N3: I want to be a role model for my child. My motherhood makes me proud of this profession.
N10: Whenever there are new technologies or knowledge, the senior sisters in our department are always very proactive in learning. This has indirectly influenced me. I do not want to be mediocre, so I must study hard. Only in this way can I become a role model for younger nurses.

This demonstrates that the power of role models can effectively increase intrinsic cognitive load and enhance learning efficiency.

Active Reflection and Knowledge Internalisation

Proactive thinking: some specialist nurses mentioned the importance of proactive thinking. This aligns with a view in traditional Chinese culture: "Learning without thinking leads to confusion; thinking without learning ends in danger". If one only listens to the teacher without thinking about the problems, one will be muddled and gain nothing. If one only daydreams without learning, one will be full of doubts and uncertainties. Only by combining learning with thinking can one truly master knowledge.

N2: I found that if I just study blindly, listen without thinking, I do not really understand the knowledge, and it will not be firmly grasped. I must think.
N3: This is a learning method advocated by Confucius in traditional Chinese culture. I think learning and thinking must be closely connected.

This shows that proactive thinking can effectively increase the intrinsic cognitive load and improve learning efficiency.

Review the old to learn the new: Most interviewees mentioned the importance of reviewing the old to learn the new. They believe that one must review in a timely manner after learning, revisiting knowledge acquired in the past. This not only consolidates what has been learned but also allows for new insights and understanding.

N10: I think that to learn well, one must review the old to learn the new. Master the knowledge learned, summarise it and then digest and understand the existing knowledge to elevate the knowledge to a new level.
N9: Reviewing my notes every day and reviewing the old to learn the new has made me progress faster.

This shows that reviewing the old to learn the new can effectively increase the intrinsic cognitive load and improve learning efficiency.

Result Verification

During the research process, we sent the extracted themes and sub-themes to the participants to verify the authenticity of the content. We provided descriptions of each theme and sub-theme to ensure that participants could clearly understand the research findings. After receiving the content, the participants gave feedback via Email or phone to confirm whether it reflected their actual experiences during the training process. Based on their feedback, we made necessary adjustments to the findings to ensure the authenticity and accuracy of the content.

Discussion

This study not only applied CLT but also contributed to its development and offered new insights. It identified new types of cognitive load and influencing factors. For example, it explored the specific manifestations of intrinsic and extrinsic cognitive loads experienced by nurses during training, as well as ways to reduce these loads through the optimisation of teaching methods. Furthermore, the study offered a novel methodological perspective, such as the use of multimedia teaching and case analysis to reduce extrinsic cognitive load.

This study selected samples from Northeast China. However, whether the research findings are applicable to other regions or other types of ESNs training programmes still requires further exploration. There are similarities and differences in ESNs training across regions, both domestically and internationally. For example, domestic training programmes usually place more emphasis on the delivery of theoretical knowledge, whereas international programmes tend to focus more on the development of practical skills.[20] The reasons for these differences may include variations in educational systems, allocation of medical resources and cultural backgrounds, among others. These differences also have varying impacts on cognitive load. Domestic nurses may experience greater intrinsic cognitive load during the theoretical learning stage, whereas international nurses may face greater extraneous cognitive load during practical training.[21] Despite the differences in training programmes across regions, the application of CLT in the field of medical education is universal. The findings of this study can serve as a reference for training programmes in other regions, especially in optimising teaching methods and reducing cognitive load.

Optimisation Approaches for Intrinsic Load

This study found that the main reasons for the high intrinsic load among specialist nurses during the training implementation process were the complexity of the epilepsy discipline and their lack of knowledge. Intrinsic cognitive load[22] refers to the load generated when working memory cognitively processes the information elements contained in the learning task itself and their interactions. In medical education curriculum design, it is necessary to reduce the number of elements contained in the learning content itself to achieve the goal of reducing intrinsic cognitive load.[23] The complexity of epilepsy specialist knowledge (such as EEG and neuroanatomy) is the main source of intrinsic load. How to simplify the complex epilepsy discipline to enable students to learn better and reduce the load is the key to future curriculum design. Complex teaching content can be divided into several simpler parts and presented to students step by step to avoid overloading their cognitive capacity by presenting too much information at once.[24]

According to the "element interaction effect" principle of CLT, when a learning task contains too many interactive elements, working memory is prone to overload. This study proposes a three-stage splitting strategy:

1. Basic principle stage: simplify basic EEG concepts (eg abnormal discharge patterns) and avoid introducing anatomical and electrophysiological knowledge simultaneously (N9: "It's much less stressful to learn separately").

2. Pattern recognition stage: enhance pattern recognition ability through the comparative training of typical epileptiform EEG patterns (eg spike-and-wave complexes) (N2: "It's more intuitive to learn from images than from pure theory").
3. Clinical decision stage: facilitate knowledge integration by combining case simulations (eg drug selection for refractory epilepsy) (N7: "The step-by-step approach makes it truly applicable in clinical practice").

This strategy aligns with the segmented teaching approach proposed by Sweller et al. Their research shows that presenting complex knowledge in stages can reduce intrinsic cognitive load by 30%.[7] International comparisons indicate that the United Kingdom's ESNs training employs a similar modular teaching method, dividing epilepsy care into three modules: seizure management, medication management and long-term follow-up. This approach has increased the theoretical assessment pass rate among trainees by 25%, further validating the universality of knowledge segmentation in reducing intrinsic cognitive load.[24,25]

Cross-Cultural Differences in External Load

In China, ESNs training often relies on traditional lectures (N3: "Too much text on PPTs, forgotten right after listening"). In contrast, the ESNs programme in Australia reduces extraneous load through virtual reality (VR) scenario simulation.[26] For example, in training for status epilepticus nursing, VR technology can dynamically present changes in patients' vital signs (such as a sudden drop in SpO_2), and trainees are required to make real-time decisions (such as adjusting the dosage of antiepileptic drugs). Its advantages lie in the following:

1. Reducing information redundancy: visualising dynamic data instead of using textual descriptions aligns with the channel principle of CLT.
2. Enhancing immersion: incorrect operations by trainees trigger deterioration in the virtual patient's condition, reinforcing the trial-and-error-feedback mechanism (N8: "Ten times more realistic than paper cases").

A comparison found that the operation accuracy rate of Australian trainees after VR training (92%) was considerably higher than that of the traditional training group in China (68%),[26] suggesting that China needs to accelerate technology integration to optimise the allocation of teaching resources. This study found that extraneous cognitive load in specialist nurse training is mainly caused by teaching methods, approaches and learning environments. The main factors contributing to increased extraneous cognitive load include unreasonable task presentation methods and external distractions.[27] Therefore, to achieve ideal training and learning outcomes, it is essential to reduce extraneous cognitive load.

First, specialist nurses should be assisted in focusing their attention and learning, and the amount of information that working memory needs to process should be controlled. In this training, the group cooperative learning method[28] was adopted. Cooperative learning can reduce the working memory load of individuals within the group. To better present information, it is necessary to choose appropriate teaching methods, combine text with graphics, avoid lengthy paragraphs, mark and highlight the information that needs attention, carefully select and describe keywords and control the overall teaching pace. In the workshop scenario simulation cases, the extraneous load often arises from the complexity of the simulation environment and the cases. Providing clear pre-briefings and successful case content helps reduce extraneous load during situational case drills. Thach et al[29] designed a learning method to optimise extraneous cognitive load by showing medical students the underlying logic behind problem-solving. By providing students with the diagnostic process for a certain disease and displaying the entire reasoning process in an arrow-pointing pattern on a diagram, students can draw inferences about other cases and apply more cognitive resources to the task at hand and the available problem-solving methods. This simplifies the problem-solving process and reduces extraneous cognitive load unrelated to task completion, ultimately improving their diagnostic ability.

In addition, Bandura's social learning theory[30] emphasises the role of observational learning and imitation in skill acquisition. In specialist nurse training, methods such as role-playing and simulated patient interactions can increase interactivity and practicality, thereby reducing extraneous load.

Culture-Driven Correlated Load

This study found that professional beliefs (eg learning without thinking leads to confusion) are the core driving force behind intrinsic cognitive load. Cultural mechanism analysis indicates that the internalisation of Confucian thought, such as "reviewing the old to learn the new", promotes knowledge reflection (N10: "Reviewing notes every day is essential for digestion"), which aligns with the elaboration processing principle of CLT[31] and also conforms to the core principle of "reducing extraneous load and enhancing intrinsic load" in CLT.[7] Practical applications of social learning theory show that through role-playing (eg simulating the role of a teaching mentor), nurses internalise the behaviours of professional role models as their own standards (N3: "Aspiring to be a role model for younger nurses"), consistent with Bandura's (1977) theory of observational learning.[32] International comparisons reveal that Western countries rely more on external incentives (eg credit certification) to enhance intrinsic cognitive load, whereas domestic strategies can leverage culturally adaptive approaches, such as strengthening "team debriefing", to stimulate intrinsic motivation. For instance, adding a "self-reflection" session (eg completing a reflection journal) after case discussions can increase knowledge retention rates by 40%. Domestic teaching can enhance professional identity through role-playing, thereby optimising the allocation of cognitive resources.

Learning is always challenging, and specialist nurses proactively invest their cognitive resources in the learning process. Employing methods such as association, induction, and summarisation can increase relevant cognitive load. Educators can monitor students' learning processes during teaching and provide timely feedback and guidance, stimulating students to engage in self-reflection during learning – whether they apply learned knowledge in practice, whether their methods are correct and whether they have gained insights. This enables students to identify gaps and enhances teaching effectiveness.[33] In the post-work review session, learners can be guided to actively participate in group discussions and case analyses, fostering deeper thinking and understanding of their own performance. This deepens impressions and, by integrating traditional Chinese culture, encourages training nurses to self-explain and reflect, cultivating their thinking abilities. At the same time, learning content can be streamlined, diverse learning methods can be utilised, learning time can be reasonably arranged and external tools can be employed to assist learning, thereby improving work and learning efficiency.[34] By applying CLT to activate brain potential, learners can enjoy efficient and engaging learning experiences. In the future, Bloom's taxonomy of educational objectives in the cognitive domain could be considered when designing training courses for ESNs to reduce intrinsic load. Virtual reality and other immersive technologies can be used to provide trainees with simulated clinical operation experiences. Additionally, Bandura's social learning theory and a combination of various teaching methods can be applied to reduce extraneous load.[35] The cognitive approach of "learning, thinking and practising" from Confucianism in traditional Chinese culture can also reduce extraneous cognitive load. A solid professional belief is the driving force for trainees' learning, and a good career plan and practice environment are conducive to cultivating the talents of ESNs, serving their professional growth and development.[36]

Limitations

This study has certain limitations. First, phenomenological research is subject to some degree of subjective bias as it relies on participants' subjective descriptions, which may be affected by recall bias. Credibility is enhanced through triangulation, including interviews, observations and literature comparison. Second, this study only included nurses from tertiary hospitals; future research should expand to include those from primary-level hospitals. Additionally, a mixed-methods research design was not employed; subsequent studies could incorporate quantitative data, such as workload scale scores, to strengthen persuasiveness. To overcome these limitations, future research could increase the sample size to include more regions and different types of training programmes. Moreover, combining various research methods, such as integrating quantitative and qualitative approaches, could enhance the reliability and validity of the findings.

Conclusions

In ESNs training in Northeast China, intrinsic load stems from the complexity of knowledge, extraneous load is influenced by teaching methods and germane load depends on the drive of professional beliefs. This type of training in Northeast China needs to be centred around CLT, implement layered teaching according to Bloom's taxonomy, introduce VR simulations and case workshops and simultaneously establish policy support for a regional ESNs certification system to strengthen professional identity, reduce the load and enhance efficiency. In the future, cross-cultural adaptive training models can be explored to provide new paradigms for the equalisation of regional medical resources.

In this work, the principal barriers were: (1) High intrinsic load from epilepsy knowledge complexity (eg, neuroanatomy difficulties per N9's report); (2) Extraneous load induced by resource disparities, particularly EEG equipment shortages in primary hospitals causing first-exposure barriers; (3) The need to integrate Western CLT with Confucian learning principles for germane load enhancement. Mitigation strategies were directly derived from empirical findings: Implementation of the three-stage training decomposing complex knowledge; Adoption of VR simulations to present dynamic clinical scenarios; And leveraging dual pathways of professional role modeling and active knowledge reflection.

Data Sharing Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of The first hospital of Jilin University (Approval No. K2024276). Written informed consent was obtained from all participants.

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References

1. Thijs RD, Surges R, O'Brien TJ, Sander JW. Epilepsy in adults. *Lancet*. 2019;393:689–701. doi:10.1016/S0140-6736(18)32596-0
2. Allers K, Essue BM, Hackett ML, et al. The economic impact of epilepsy: a systematic review. *BMC Neurol*. 2015;15(1):245. doi:10.1186/s12883-015-0494-y
3. Ding D, Zhou D, Sander JW, et al. Epilepsy in China: major progress in the past two decades. *Lancet Neurol*. 2021;20(4):316–326. doi:10.1016/S1474-4422(21)00023-5
4. Greenhill L, Betts T, Pickard N. The epilepsy nurse specialistexpendable handmaiden or essential colleague? *Seizure*. 2001;10(8):623–624. doi:10.1053/seiz.2001.0649
5. Rapport F, Hutchinson K, Herkes GK, et al. Determining the role and responsibilities of the Australian epilepsy nurse in the management of epilepsy: a study protocol. *BMJ Open*. 2021;11(1):e043553. doi:10.1136/bmjopen-2020-043553
6. Xiong LL. Application of clinical nursing pathway in epilepsy care and analysis of patient satisfaction. Taihe Hospital; 2024.
7. Sweller J, van Merriënboer JJG, Paas F. Cognitive architecture and instructional design: 20 years later. *Educ Psychol Rev*. 2019;31(2):261–292. doi:10.1007/s10648-019-09465-5
8. Szulewski A, Howes D, van Merriënboer JJG, Sweller J. From theory to practice: the application of cognitive load theory to the practice of medicine. *Acad Med*. 2021;96(1):24–30. doi:10.1097/ACM.0000000000003524
9. Yin Q, Cai D, Prunus M, Tang X, Wang Y, Pang D. Effect evaluation of stepwise training based on cognitive load theory applied to new nurses. *J Nurs*. 2020;27(7):20–24. doi:10.16460/j.issn1008-9969.2020.07.020
10. Chinese Association Against Epilepsy. *Clinical Practice Guidelines for Epilepsy (Revised Edition 2023), Volume on Epilepsy Diseases*. Beijing: People's Medical Publishing House; 2023:10–39.
11. Jia Z, Balinas JM. Teaching strategies in psychiatric nursing based on Bloom's taxonomy of educational objectives. *Cureus*. 2024;16(4):e57759. doi:10.7759/cureus.57759

12. Mukhalalati B, Elshami S, Eljaam M, et al. Applications of social theories of learning in health professions education programs: a scoping review. *Front Med*. 2022;9:912751. doi:10.3389/fmed.2022.912751
13. Polit D, Beck C. *Essentials of Nursing Research: Appraising Evidence for Nursing Practice*. Lippincott Williams & Wilkins; 2020.
14. Shi YY, Zhang H, Zhao YM. Parameter selection for sample size estimation in clinical research. *Chin J Pediatr*. 2024;62(4):350. doi:10.3760/cma.j.cn112140-20240204-00097
15. Zhang MY, Guo LN, Guo YL, et al. A qualitative study on the promoting factors and barriers to healthy behaviors in stroke patients. *Chin J Behav Med Brain Sci*. 2024;33(1):27–31. doi:10.3760/cma.j.cn371468-20230320-00131
16. Chen YY, Pi HY. Application progress of theoretical domain framework in nursing research. *Chin J Mod Nurs*. 2023;29(33):4617–4620. doi:10.3760/cma.j.cn115682-20230330-01240
17. You ZL. How to Evaluate the Representativeness of Samples? *J Huazhong Norm Univ*. 2009;48(3):123–126.
18. Liu M. Application of Colaizzi's seven steps in the analysis of phenomenological research data. *Chin J Nurs*. 2019;34(11):90–92. doi:10.3870/j.issn.1001-4152.2019.11.090
19. Zeng M, Sun XM. Role functions and development status of epilepsy specialist nurses abroad. *Chin J Nurs Manage*. 2018;18(7):944–947. doi:10.3969/j.issn.1672-1756.2018.07.018
20. Schultz RJ, Shafer PO, Owens S, Kakacek J, Farrell K. Project ECHO telementoring program in epilepsy for school nurses. *Epilepsy Behav*. 2023;140:109114. doi:10.1016/j.yebeh.2023.109114
21. Ma XP, Li YP, Yang R, Zhou D, Li JM. Challenges of patients with epilepsy and measures for improving epilepsy care in western China: a qualitative study. *Epilepsy Res*. 2021;178:106788. doi:10.1016/j.eplepsyres.2021.106788
22. Bradley PM, Lindsay B, Fleeman N. Care delivery and self management strategies for adults with epilepsy. *Cochrane Database Syst Rev*. 2016;2(2):CD006244. PMID: 26842929; PMCID: PMC7390263. doi:10.1002/14651858.CD006244.pub3
23. Higgins A, Downes C, Varley J, Doherty CP, Begley C, Elliott N. Rising to the challenge: epilepsy specialist nurses as leaders of service improvements and change (SENsE study). *Seizure*. 2018;63:40–47. PMID: 30399460. doi:10.1016/j.seizure.2018.10.013
24. Jiang M, Yang J, Zhang C, et al. Clinical studies with traditional Chinese medicine in the past decade and future research and development. *Planta Med*. 2010;76(17):2048–2064. doi:10.1055/s-0030-1250456
25. Zhang S, Wu Y. Application progress of cognitive load theory in the field of medical education. *Chin J Nurs Educ*. 2023;20(2):240–244. doi:10.3761/j.issn.1672-9234.2023.02.020
26. Locatelli G, Ausili D, Stubbings V, Di Mauro S, Luciani M. The epilepsy specialist nurse: a mixed-methods case study on the role and activities. *Seizure*. 2021;85:57–63. PMID: 33486343. doi:10.1016/j.seizure.2020.12.013
27. Vignato J, Inman M, Patsais M, Conley V. Computer-assisted qualitative data analysis software, phenomenology, and Colaizzi's method. *West J Nurs Res*. 2022;44(12):1117–1123. PMID: 34238074. doi:10.1177/01939459211030335
28. Hanham J, Castro-Alonso JC, Chen O. Integrating cognitive load theory with other theories, within and beyond educational psychology. *Br J Educ Psychol*. 2023;93(Suppl 2):239–250. PMID: 37208145. doi:10.1111/bjep.12612
29. Thach TH, Blissett S, Sibbald M. Worked examples for teaching electrocardiogram interpretation: salient or discriminatory features? *Med Educ*. 2020;54(8):720–726. doi:10.1111/medu.14066
30. Wilby KJ, Paravattil B. Cognitive load theory: implications for assessment in pharmacy education. *Res Soc Adm Pharm*. 2021;17(9):1645–1649. doi:10.1016/j.sapharm.2020.12.009
31. Huang WT, Zhou XY, Fu GJ. Application of group cooperative learning method in strengthening the comprehensive professional ability of new enrolled nurses. *Qilu Nurs J*. 2024;30(2):82–85. doi:10.3969/j.issn.1006-7256.2024.02.026
32. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84(2):191–215. doi:10.1037/0033-295x.84.2.191
33. He Q, Zhong FH, Yu L, Chen YY. The influence of information overload on information users and countermeasures. *J Med Inform*. 2010;31(5):41–43,47. doi:10.3969/j.issn.1673-6036.2010.05.011
34. Hessler KL, Henderson AM. Interactive learning research: application of cognitive load theory to nursing education. *Int J Nurs Educ Scholarsh*. 2013;10:133–141. doi:10.1515/ijnes-2012-0029
35. Atiomo W, Ennab F, Stanley A, Ezimokhai M. Evaluating an obstetrics and gynecology teaching program for medical students incorporating simulation-based education underpinned by cognitive load theory. *Front Med*. 2024;11:1304417. PMID: 38590321; PMCID: PMC10999601. doi:10.3389/fmed.2024.1304417
36. He BQ, Zhang LL, Lin JQ, et al. Collaborative learning model guided by metastrategy and teaching of health assessment course. *China High Med Educ*. 2011;2011(10):66–67.