Design and Research of Ultrasonic Diagnostics Online Teaching Based on Blackboard

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Abstract. With the continuous development of medical ultrasound diagnostics technology, ultrasound in obstetrics and gynecology has become an essential branch of ultrasound medical diagnostics, and increasing attention has been paid to the teaching of ultrasound in obstetrics and gynecology diagnostics. Based on the modern blackboard network platform and mobile video monitoring technology, a vivid and intuitive online course of ultrasound diagnostics in obstetrics and gynecology is established, which is conducive to implementing communications and interactions among students, teachers, and resources, improving the teaching quality and learning efficiency, and cultivating ultrasound diagnostics skills of medical students.

Keywords: Ultrasound Diagnostics in Obstetrics and Gynecology, Blackboard Platform, Mobile Video Monitoring, Online Course, Design

1. Introduction
CT, MRI, ultrasound, and radionuclide imaging are the four modern medical imaging technologies. Different from doctors in the other three technologies, ultrasound doctors have the characteristics of “medical and technical integration”[1-2]. Ultrasound examination needs to obtain the best display of disease image through real-time, continuous, multi-perspective dynamic changes of the section, through the analysis of the objective image to identify various lesions, understand the law of disease occurrence and development to reveal the nature of the diseases[3-4]. The experimental teaching of ultrasonic diagnostics is an essential supplement to the theoretical teaching. It aims to cultivate the practical operation skills and diagnostic capabilities of students playing a vital role in strengthening the comprehensive quality education and ability training of students. Based on the characteristics, the experimental teaching of ultrasound diagnostics should be reformed and explored under the background of big data, focusing on clinical needs, and following the development trend of digital and network of image resources[5-6].

In recent years, with the continuous development of ultrasound technology, the resolution of
ultrasound scanning image, and the improvement of scanning frame rate, the application of ultrasound in the diagnostics of gynecology and obstetrics has entered a new stage. The examination method has developed from the original simple abdominal wall ultrasonography to a variety of examination methods, such as transvaginal, transrectal, transuterine, and transperineal ultrasonography. Its clinical significance has also expanded from the original simple ultrasound diagnostics to ultrasound diagnosis and treatment, such as the use of interventional ultrasound. Currently, ultrasonography in gynecology and obstetrics has become an essential basis for the diagnostics and differential diagnostics of gynecological diseases, prenatal diagnostics of fetus and evaluation of fetal growth and development. Therefore, more and more attention has been paid to the ultrasound diagnostics of Obstetrics and gynecology in medical education, especially in imaging and obstetrics education. The Department of Obstetrics and Gynecology of the Second Affiliated Hospital of Sun Yat-sen University is the critical discipline of Sun Yat-sen University and the Department where the excellent courses of Guangdong Province are located. The Department of Ultrasound in obstetrics and gynecology has accumulated a large number of clinical cases and imaging data. Currently, it is committed to the construction of online courses to make the ultrasonic teaching methods intuitive, the teaching contents visualized, and the teaching methods connected.

2. Teaching Resources of Ultrasound Diagnosis and Treatment Online Course in Obstetrics and Gynecology

Blackboard is one of the online course development tools, which is a powerful and convenient online teaching platform. The Blackboard teaching platform has combined the virtual teaching environment of network “teaching” and “learning” with the curriculum as the center. Teachers can establish online courses on the platform, and learners can select the course contents to learn independently as guided by the teachers. Different students, teachers and students can discuss and communicate according to the needs of “teaching and learning”. Teachers can use “blackboard” and the existing “classroom teaching” to organically combine, carry out network-based auxiliary teaching activities, help teachers to solve many difficulties currently faced, improve the efficiency of classroom teaching, reduce repeated labor, and improve the overall teaching quality. The functions of the teacher blackboard platform mainly include the following: resource management, online communication, assessment management, system management, etc. Teachers can log in to the platform with netid password to create and set courses. Through the platform, the college plans the course of ultrasound diagnosis and treatment in obstetrics and gynecology.

Given sample data set, \(D = \{x_1, x_2, ..., x_n\}, x_i \in \mathbb{R}^d, i = 1, ..., n\). Assume that the first sample is labeled as \(c = (x_1, x_2, ..., x_i)\), corresponding label \(\eta = \{y_1, y_2, ..., y_i\}\).

Given the classification problem, the following symbols are used:
- \(S = \{(x_i, x_j) : x_i \text{ and } x_j \text{ are in the same category. } x_j \text{ is a near neighbor of } x_i \}\).
- \(R = \{(x_i, x_j, x_k) : x_i, x_j \text{ are in the same category. } x_i \text{ and } x_k \text{ are not in the same category} \}\).

In the classification problem, the importance of each feature dimension is different. To some extent, the big data weak symmetric manifold can overcome the shortcoming that the big data weak symmetric manifold treats each feature dimension equally. Its definition is as follows:
The big data weak symmetric manifold between sample $x_i$ and $x_j$ is defined as follows

$$d_A(x_i, x_j) = \sqrt{(x_i - x_j)^T A(x_i - x_j)},$$  \hspace{1cm} (1)$$

$x_i \in R^d$, $A \in R^{d \times d}$ It is a symmetric semi positive definite matrix.

According to the properties of semi positive definite matrix, $A$ can be broken down into $A = L^T L$:

$$d_A(x_i, x_j) = \sqrt{(x_i - x_j)^T A(x_i - x_j)}$$

$$= \sqrt{(x_i - x_j)^T L^T L (x_i - x_j)}$$

$$= \sqrt{(Lx_i - Lx_j)^T (Lx_i - Lx_j)}.$$  \hspace{1cm} (2)$$

It is equivalent to the matrix as a mapping, mapping the data of the original space to the new space, and transforming the big data weak symmetric manifold of the original space into the big data weak symmetric manifold of the new space.

Ultrasound in obstetrics and gynecology is the core of teaching. We select the essentials of ultrasound diagnostics of gynecology and obstetrics and ultrasound monitoring of gynecology and obstetrics as the teaching materials. Its teaching contents mainly include the following: early ultrasound screening of fetal malformation, current situation and Prospect of early pregnancy congenital heart disease screening, ultrasound monitoring of early pregnancy embryo, abortion, ectopic pregnancy, gestational trophoblastic disease, fetal development abnormality, fetal appurtenance abnormality, pregnancy complications, skull malformation, facial malformation, fetal heart structure malformation and abnormality, digestive tract malformation, urinary tract malformation Systemic malformation, spinal column, limb skeletal malformation, twin pregnancy dysplasia, fetal tumor, fetal edema and serous cavity effusion, prenatal ultrasound screening for chromosomal abnormalities, chorionic villus biopsy, extraembryonic cavity puncture, early amniocentesis, amniocentesis, amniocentesis and amniotic fluid replacement, ultrasound-guided percutaneous umbilical vein puncture, fetal intrauterine blood transfusion, fetal reduction, intrauterine therapeutic drainage of fetus, ultrasound intervention of ectopic pregnancy, ultrasound intervention of placenta implantation, ultrasound contrast, abnormal development of female reproductive organs, endometriosis, hysteromyoma, endometrial cancer, cervical cancer, uterine sarcoma, ovarian tumor, pelvic inflammatory mass, ultrasound diagnostics of IUD, etc.

3. Teaching design of ultrasound diagnosis and treatment online course in obstetrics and gynecology

Based on the characteristics of the online course, nine teaching modules are set up, including course introduction, teaching conditions, teaching staff, teaching syllabus, teaching content, teaching video, Teaching Library, teaching results, and teaching evaluation. The collection of teaching materials includes text, graphics, audio, video, and animation, mainly including text of teaching materials,
teaching plans, question banks, relevant materials (academic papers and academic cutting-edge, dynamic materials), pathological sections, general specimens, ultrasound picture banks, ultrasound operation video, teaching animation produced by flash and 3DMAX software, etc. The teaching content is organized based on the teaching materials and the sequence of chapters and sections.

During the course, the network username and password are assigned based different levels of students. Students only need to be equipped with a mobile phone that can browse the Internet to enable GPRS function, to realize online real-time ultrasound diagnostics internship and observation. For details, please refer to the relevant chapters of ultrasound monitoring in obstetrics and gynecology. The author can combine the Blackboard teaching platform with the medical ultrasonic diagnostics and monitoring system established by the college to improve the interactive teaching effect, efficiency, and learning fun, as shown in the attached figure.

4. Design of the teaching effect evaluation on the ultrasound diagnosis and treatment online course in gynecology and obstetrics

Based on the platform, the courses can be accessed at any time, which is conducive to understanding the learning needs of students for online courses dynamically, to better improve online courses, so that the Blackboard teaching platform becomes a real right-hand assistant. Statistical analysis on the visit of the course from many aspects can be performed as follows summary of use, statistical analysis on the overall visit of the course; visit of the content area, statistics on the visit of the content area (courseware); visit of the group, statistics on the activities of different group members in the group; visit of the forum, statistics on the visit of the forum. Enter the “control panel” of the blackboard platform, find “course statistics” in the test area, “select report” type and “screening options”, and then “submit” to get the statistics of the above information of the course.

Figure 1. Schematic diagram of video monitoring

Image acquisition starts from the observation that the contrast agent develops in the placenta and
continues until the contrast agent completely disappears. During the whole experiment, ultrasound doctors keep the probe in the abdomen of pregnant women and constantly change the direction and position of the probe but do not adjust the frequency of the probe, and observe the diffusion and development of contrast agent in the myometrium, placenta, and fetus carefully. Meanwhile, whether pregnant women have adverse reactions to the contrast medium is observed during the process of contrast. The study showed that that after rapid injection of ultrasound microbubble contrast agent for about 5 seconds, the contrast agent was developed in the abdominal wall, myometrium, and placentas, presenting the hyperechoic areas. Placentas were the most echoic areas, and the duration of the hyperechoic regions was about 7-8 min. Subsequently, the echo gradually decreased. Finally, hypoechoic like uninjected contrast image was observed. The whole process lasts about 10-15 min, consistent with the average elimination half-life of sulfur hexafluoride (12 min).

During the whole process from the observation of the contrast agent developing in the myometrium, placenta and other parts of the uterus to the complete disappearance, no contrast agent development was observed in the fetal part. The entire fetal part showed low echo or even no echo area as shown in Figure 2. The contrast image suggests that the contrast agent did not develop in the fetal part, which is consistent with the published animal experiment results, indicating that the contrast agent was not shown in the fetal part. Hence, the drug did not pass through the human placenta barrier and was relatively safe for the fetus. In the experiment, contrast agent development was observed in the skin of the fetal umbilical ring, and there was a hyperechoic area similar to the placental development.

![Figure 2](image.png)

**Figure 2.** When the contrast agent is injected, the placenta shows apparent hyperechoic. However, the fetal part has no visible change

5. Conclusions

Medicine is an experienced subject. To acquire techniques and skills, the students need to perform many hands-on operations, especially in the study of ultrasound diagnostics. The purpose and approach of experimental teaching should focus on the theme of arousing students' interest and improving their practical operation. In the experimental teaching of ultrasonic diagnostics, the Blackboard platform should be fully leveraged, so that the students can gradually master the basic skills of ultrasonic diagnostics, cultivate clinical diagnostics thinking, and innovation capabilities.
Modern education theories, science, and technology such as Blackboard platform are used to establish the online course. The mobile phone network is combined for real-time observation, which allows the teaching activities to break through the limitation of time and space. As a new approach that can strengthen course construction and functions at present and in the future, it is a simple and practical teaching tool worth promoting.

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