Ocean coastal temperature front based on sensor network and research on the new teaching mode in colleges and universities

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Abstract
Based on the research of wireless sensor network, this paper studies the gear routing protocol from two aspects of network coding and data fusion technology. A DNC-GEAR routing protocol based on gear algorithm and an improved GEAR data fusion algorithm are proposed. By introducing sensor network coding and data fusion technology, the improved GEAR routing protocol reduces the number of packets sent through the network, propagation delay, and information redundancy. Then, in this paper, we will analyze the spatial distribution of temperature and salinity during the whole observation period based on the cross-sectional survey data along the coast in summer. The temperature front is extracted and combined with the data of sea temperature and wind field to analyze the different water layers and cross sections of the temperature front along the coast of the ocean and to study its distribution, mixing process, and parameterization. When the seawater temperature front is bent or deformed by wind or interaction with environmental factors, its velocity and shear force increase, the convergence and divergence process become stronger, and it mixes with the sub-mesoscale process. These processes can improve the material and energy exchange on the front surface. Now, the new teaching mode plays an important role in education. The new teaching mode of the Internet has become an indispensable tool for teachers in the process of education. However, although the Internet teaching mode provides convenient and favorable classroom teaching conditions for teachers, it also brings some negative effects. In this paper, through the research of the sensor network, it is applied to the research of the coastal temperature front and the new teaching mode in colleges and universities, so as to promote the development of the future temperature front and teaching mode.

Keywords  Sensor network · Along the coast of the ocean · Temperature front · New teaching mode

Introduction
In this paper, GEAR protocol does not use data fusion technology, so the source node in the target region has a significant redundancy problem in the process of returning the collected data. In the process of collecting data to the routing protocol, data fusion technology is introduced. Hierarchical data fusion method is used to reduce the data traffic in sensor networks (Lee et al. 2001). The data collected by the source nodes in the target region is averaged according to the confidence interval to reduce the data flow from the data source. For the data sent from multiple source nodes to the same transmission node, the idea of k-clustering is used to delete the small deviation data, and then the adaptive equal data fusion method is used to perform the data fusion operation. By fusing these two layers of data, the redundant data in the sensor network can be effectively deleted, and the traffic in the sensor network can be reduced to extend the network life cycle (Ma et al. 2013).
Finally, the feasibility of the improved gear data fusion algorithm is verified by using MATLAB simulation analysis (Lee and Pradhan 2007). The sub-mesoscale dynamics and instability of different types of vertical frontal patterns along the ocean coast are also discussed. Although various types of frontal structures have unique dynamic characteristics, the vorticity, divergence, and horizontal elongation of the whole frontal region are generally close to normal distribution. On the side near the coast of the ocean, the water tends to be unstable (Makealoun et al. 2015). On the cold water side of the coast,
Material and methods

Data source

The remote sensing data used in this paper mainly include sea surface temperature and wind field. Sea surface temperature data is the fusion of various data provided by NOAA, mainly including AVHRR, AATSR, SEVIRE, MSRE, TMI, other satellite data, and field observation data. In addition, the sea-level equilibrium velocity used in this paper is proposed by Aviso (Suzen and Doyuran 2004).

Sbe19 plus thermal salt-depth meter (CTD) manufactured by seabird marine instruments was used to obtain temperature and salinity data, and the sentinel self-contained acoustic Doppler velocity curve created by us Laure was used to obtain horizontal flow field data. The ADCP is suspended 6 m underwater from the side of the ship, and the sampling interval is 1 m. In addition, the mixing ratio and dissipation ratio of the three cross sections of F, h, and G are observed. The equipment used is turbo map-l micro profiler produced by the Alec company of Japan, which has two shear probes. Multiple observations were made at each site (Santini et al. 2009).

Structure design of wireless sensor network

Wireless sensor network (WSN) is composed of sensor nodes and sink nodes distributed in the detection area. However, a large number of conventional sensors are randomly scattered in specific areas to collect monitoring data. Monitoring data is usually sent from the source node (Valencia Ortiz and Martinez-Graña 2018). The intermediate node receives the data as a relay, forwards it to the next node, and finally sends it to the aggregation node. The aggregation node uploads the monitoring data detected by the nodes in the sensor network and sends it to the base station through connecting the internal and external networks of the sensor system, so as to provide the required services for users. The system architecture is shown in Fig. 1.

The network is mainly composed of data collection network, information transmission network, and task management network. The normal operation mode is to distribute normal sensor nodes randomly in the monitoring area and realize data monitoring function in the area through wireless self-organization for adaptive networking. Internally, each node has the ability to collect data and select a transmission path. The collected data is usually sent to the receiving node in multi-hop mode. The process of data transmission to the destination node may involve multiple fusion processes to improve the accuracy and reliability of the collected information.

Calculation of coastal temperature front

The definition of the frontal lobe is different, but the most significant feature is the rapid change of hydrological elements in the frontal area. The position of the frontal zone can be determined by the intensity of one or more hydrological factors. At present, the main front detection algorithms are the gradient coefficient threshold method, histogram analysis method, edge detection operator method, and entropy detection method. The gradient coefficient threshold method is a simple and practical gradient recognition method (Yalcin et al. 2011). In this method, the gradient value of each point in the study area is calculated first, and then the appropriate gradient value is selected as the threshold (critical value) according to the experience, and then the gradient is taken as the threshold. Histogram analysis assumes that the front surface is an elongated band structure, which separates the two water masses. The elements on both sides of the front surface are concentrated in two different stable patterns (in the histogram, two important fronts are shown). The front area between the two water masses shows a random distribution in the temperature histogram. Entropy detection method has been proposed by Vazquez et al. The advantage of this method is that it reduces the impact of pulse and Gaussian noise on front detection.

In this paper, we use Sobel algorithm of gradient coefficient threshold method to obtain the temperature front. In order to solve the difference between the center points, Sobel algorithm also gives different weights to the difference between the adjacent grid directions and fully considers the
influence of the surrounding grid points on the center points. It can restrain the noise produced by data processing to some extent and improve the visibility of digital image edge effectively.

\[ G = \sqrt{G_x^2 + G_y^2} \]  

Among them,

\[ G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} \times \frac{1}{4} T; G_y \]

\[ = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} \times \frac{1}{4} T \]  

The generation of seashore involves the generation of vertical velocity in the coastal area. The vertical movement of the water body can transport the cold water from the bottom rich in soluble and particulate matter upward to the transparent area. This determines the size and structure of marine phytoplankton. In addition, the vertical velocity also plays an important role in the deposition and transportation of pollutants. Therefore, the determination of the vertical velocity of the coastal zone is the basis and key to understand the dynamic process of the coastal zone and calculate other dynamic parameters.

In this study, CTD and ADCP were used to collect the observed data of horizontal flow field and density field in the Qiongdong shelf area \( \omega \). The equation calculates the vertical velocity. The equation can be obtained by using quasi-geostrophic approximation and used to diagnose the vertical velocity of the geostrophic current field.

\[ u_a = u - u_g; V_a = V - V_g \]  

where \( u \) and \( V \) are field velocities. Quasi-geostrophic \( \omega \) equation:

\[ N^2 \nabla^2 W + f^2 W_{zz} = 2 \nabla_h \cdot \frac{Q_h}{C_1} + f \zeta_{ph} \cdot \nabla_h u_h \]  

The turbulent energy dissipation rate is calculated based on the measured data of turbo map. During the descent process, ensure that the equipment falls freely and eliminate the interference of other external forces as far as possible. Turbo map shear probe can directly measure the change rate of horizontal flow with time and use Taylor freezing theorem to obtain the vertical flow shear. Then, the shear spectrum can be calculated and the turbulent energy dissipation rate can be obtained using the following equation:

\[ \varepsilon = 7.5 \nu (\partial u / \partial z)^2 = 7.5 \nu \int_{k_1}^{k_2} \psi(k) dk \]  

Results

Variation characteristics of temperature and wind field in the study area

The annual mean value of the 6-year mean SST of each month in the two waters was calculated, and then the SST change process of each area was calculated according to the results. The general trend of changes in the continental shelf waters and the high seas is roughly the same. In the continental shelf waters, the warming period is from February to June, and SST increases every month. The cooling period is from August of the first year to February of the second year, and SST decreases once a month. Therefore, the boundary time for the rise and fall of water temperature on the continental shelf is June and August, respectively, while the boundary time for the rise and fall of offshore water temperature is June (Table 1).
The annual average maximum SST (as shown in Table 2) of water on the continental shelf appears in 2019, the minimum value appears in 2015, and the maximum change in 2014 reaches 13.15 °C. The average monthly maximum SST mainly occurred in summer and May 2012. The smallest monthly average SST occurred mainly in January, while 2016 and 2017 occurred in February. According to the analysis of the 6-year average SST curve in Fig. 1, the average annual SST value from 2015 to 2020 is about 26.5 to 26.9 °C. The annual average SST decreased from 2015 to 2016. After that, the annual average SST value will gradually increase and reach the maximum value in the past 6 years in 2020.

The statistics of monthly and 6-year average wind speed in the two sea areas are shown in Table 3.

The annual average wind speed in the survey area is calculated, and the annual average wind direction is expressed in the form of Table 4, which is divided into shelf sea area and high seas area for statistical analysis.

### Seasonal variation characteristics of coastal temperature front

In recent years, oceanographers have studied the seasonal variations of the seafront in the South China Sea and the northern South China Sea, revealing some mesoscale variations. This paper focuses on the Qiongdong continental shelf waters and discusses the characteristics of SST front variation. Figure 2 shows the 12-month SST rise time in the water area. It can be seen from the figure that the seasonal variation of the front part is very large, and the variation law is basically consistent with the previous research. The front is mainly distributed along the continental shelf, with the strongest in winter and the weakest in spring and summer. Completely disappeared in autumn. In winter, due to the influence of the seasonal monsoon, the whole surface of the South China Sea presents the form of cyclonic circulation. The surface circulation and ocean current in the east coast of the Qiongdong area merge with the warm current in the South China Sea to form a very strong temperature front.

When the summer tide subsides, there may be a relatively strong tidal area in Qiongdong waters. This is mainly related to the coastal rise in summer. The southwest monsoon in summer leads to the offshore transportation of Ekman and enhances the horizontal temperature and salt gradient. Rolling et al. studied the seasonal and annual fluctuations of sea surface temperature fronts in the Beibu Gulf and found that there was a specific response relationship between the front intensity and SST anomaly (SSTA). In the Qiongdong water area, the frontal line is very strong in winter and spring. In terms of the range and intensity of the

| Area                | January | February | March | April | May | June | July | September | October | November | December |
|---------------------|---------|----------|-------|-------|-----|------|------|-----------|---------|----------|----------|
| Shelf sea area (°C) | 22.9    | 22.5     | 23.8  | 26.2  | 28.6| 29.5 | 29.4 | 29.3      | 28      | 26.5     | 24.6     |
| Open sea area (°C)  | 24      | 23.5     | 25    | 27.2  | 29.2| 29.8 | 29.7 | 29.5      | 28.1    | 26.9     | 25.6     |
| Difference (°C)     | 1.11    | 1.03     | 1.15  | 1.02  | 0.62| 0.37 | 0.33 | 0.12      | 0.11    | 0.45     | 0.93     |
Of the horizontal temperature gradient of the sea surface. So that compared with the underground surface, the order of magnitude is smaller.

The horizontal gradients of temperature and salinity along the section are calculated. The absolute value of the gradient is shown in Fig. 5. The distributions of temperature and salt gradient in the front are basically the same. Similar to the horizontal distribution, the figure shows more clearly the layer slope structure, which gradually weakens from the upper layer near the coast to the deep sea. Among them, the temperature salt gradient distribution of K and G segments is more dispersed, and the vertical distribution of H and f segments is more consistent with the SST front.

Mixing characteristics of coastal temperature fronts

The turbulent energy dissipation rate in the front region is usually several orders of magnitude higher than that in the background field. There are many dynamic mechanisms that cause ocean turbulence, but the most basic reason is shear instability, which is caused by the different velocity of the two-layer fluid and reaches a certain threshold, namely, Kelvin Helmholtz instability as shown in Fig. 6.

### Table 3: Monthly and annual average wind speed statistics of the two sea areas

| Physical quantity | January | February | March | April | May | June | July | August | September | October | November | December |
|-------------------|---------|----------|-------|-------|-----|------|------|--------|-----------|---------|----------|----------|
| Wind speed of continental shelf sea area (m/s) | 6.4 | 5.1 | 4.2 | 3.7 | 3.6 | 3.9 | 3.5 | 3 | 2.5 | 5.5 | 6.8 | 7.7 |
| Wind speed in the open sea (m/s) | 7.5 | 5.9 | 4.4 | 3.6 | 3.9 | 4.5 | 3.8 | 3.5 | 2.4 | 6.1 | 7.7 | 9 |

### Table 4: Interannual variation of mean wind speed in two sea areas

| Sea              | Variation range (°C) | Change range (°C) | Month of maximum occurrence | Month of minimum occurrence | Average (°C) |
|------------------|----------------------|-------------------|----------------------------|-----------------------------|--------------|
| Shelf waters     | 27.78–29.86          | 12.08             | 5                           | 1                           | 26.7         |
| Offshore waters  | 22.80–29.84          | 7.04              | 5                           | 1                           | 27.3         |
| Shelf waters     | 58.15–30.08          | 11.93             | 7                           | 1                           | 26.5         |
| Offshore waters  | 23.45–30.14          | 6.69              | 7                           | 2                           | 27.1         |
| Shelf waters     | 17.58–30.73          | 13.15             | 7                           | 1                           | 26.6         |
| Offshore waters  | 32.42–30.84          | 8.42              | 7                           | 2                           | 27.3         |
| Shelf waters     | 17.76–30.42          | 12.66             | 6                           | 1                           | 26.8         |
| Offshore waters  | 22.31–30.46          | 8.15              | 6                           | 2                           | 27.5         |
| Shelf waters     | 17.34–30.46          | 12.73             | 6                           | 2                           | 26.8         |
| Offshore waters  | 22.71–30.52          | 7.81              | 6                           | 2                           | 27.5         |
| Shelf waters     | 19.15–30.39          | 11.24             | 8                           | 2                           | 26.9         |
| Offshore waters  | 22.94–30.40          | 7.46              | 8                           | 2                           | 27.4         |
Figure 7 shows the distribution of four parts: buoyancy frequency (N), shear force (S), and Richardson number (RI). It can be seen from the figure that the frequency of buoyancy and the distribution of shear force are relatively similar. The values of the two mixed layers are larger than those of the middle and lower layers and slightly higher in the front zone. Richardson number is universal, because the buoyancy frequency of these four parts is almost higher than the shear force.

It can be seen from the F and H parts that the distribution is similar to the frontal structure (Fig. 8) and inclines from the coastal surface to the deep sea. The dissipation and mixing of turbulent energy in the front are enhanced. This result is consistent with the observation of J et al, except that the increasing region of the California upwelling front is on the high-density side.

Discussion

Types of new teaching models based on smart education

Flipped classroom

Flipped classroom is very popular in many universities now, and it is not particularly novel. In the traditional process of education, teachers convey knowledge in class, while students internalize knowledge through exercises and homework after class (Althuwaynee et al. 2014). Flipped classroom is so named because these two stages are “reversed.” The knowledge to be taught is completed with the help of information technology before class, and
the internalization of knowledge is completed in class with the help of teachers and students. The key idea of flipped classroom is students’ cooperation, teacher-student interaction, timely understanding of students’ feedback, and the ability to use online resources and online interaction. From these ideas, the key of flipped classroom is the internalization of knowledge, and its effectiveness depends on a series of key points and internalization of knowledge, which can finally be completed. Therefore, the design of classroom activities is the key (Arora et al. 2004).

**Smart classroom**

Smart classroom is a smart, intelligent, and highly interactive classroom built with new technologies (such as mobile Internet, big data, and cloud computing). Intelligent classroom is an advanced model of flipped classroom, which can be said to be the development trend. The flipped classroom extends the classroom from recess to pre-class and after class, while the intelligent classroom extends the classroom from in class to extracurricular activities and from physical environment to network virtual environment to form intelligent learning.

*Fig. 3* Corresponding SST gradient threshold

*Fig. 4* Distribution of deep thermohaline front in 10-m, 20-m, and 30-m layers
space. The launch of mobile learning devices such as rain classroom will provide environment and technical support for the construction of intelligent classroom (Baeza and Corominas 2001).

**Intelligent teaching tools**

The application of information technology enables teachers to reduce the time and energy required for simple and repetitive tasks such as video playback, test practice, and data processing, so that teachers can design education plans, consult, answer questions, emotional tasks, personalized guidance, and so on (Chae et al. 2017). This is why there are many intelligent education tools related to “Internet + education,” such as rain classroom, learn Tong, cloud classroom, and umu. Combining these educational tools with a variety of new educational models can play a greater role and change the way teachers and students learn. Of course, these educational applications are just educational tools. Whether they can achieve the teaching effect depends on the teaching design and teaching ability of teachers.

**Problems in the innovation of teaching mode in colleges and universities**

The innovation of educational model is a main trend of educational reform. While developing it, there is a phenomenon called “collectivization.” We are worried that if we do not “innovate,” we will be “delayed” and eliminated, regardless of the status and characteristics of resources, especially for private universities with limited funds, teaching positions, and locations, whether it is applicable and how to develop in stages are issues that need to be seriously considered. The author continues to focus on the combination of flipped classroom teaching mode and teaching tools such as rain classroom and analyzes the problems existing in the innovation of teaching mode in Chinese private universities (Chang and Chiang 2009).

**The understanding of the new teaching mode is biased**

Flipped classroom is very popular in university, but there are still some misunderstandings about some implementations.
For example, some teachers use their mobile phones to randomly shoot poor-quality micro videos and publish them on the Internet. In class, students will interpret and give lectures or case studies in groups, which are called flipped classrooms. Some teachers think an app that can replace the course in class, so students can see the courseware recorded in the app in advance (Chau and Y. F. T. 2004). All of these are because some teachers have prejudice to the new education model, and they cannot understand that the reform of education mode is actually a change of educational thought.

Challenges of the overall reform of school teaching mode

In the long run, flipping the classroom will lead to the comprehensive reform of the school education model. If all courses adopt this new education model, students need to learn at least 10 courses per semester, about 3 courses a day, and each course will watch educational videos 10 minutes before class and at least 30 minutes before class every day (it may be longer due to factors such as network conditions, attention, and actual video duration). This will bring heavy burden on the whole student, because in pre-class study or “bolt together,” students do not seek understanding, do not have enough time and energy to finish the task, or only choose the course video they want to study hard, which leads to poor performance of some subjects, all of which weaken the knowledge supply process and cannot achieve the expected effect. Therefore, the applicability should be considered.

Applicability

Educational models such as flipped classroom and educational tools such as rain classroom are not suitable for all disciplines, courses, course types, and knowledge points. Take flipped classroom as an example.

Subject applicability The natural science curriculum has clear knowledge points, and most of the education contents (such as concepts, formulas, examples, and experiments) contribute to the implementation of flipped classroom. Humanities and social science courses may involve multiple disciplines, such as this similar subject situation; teachers and students cannot
avoid to communicate with each other in thought and emotion, and only through this way of teaching, can we better achieve the efficient results of education.

Course applicability Even in the same subject, the combination of teaching content, knowledge system, and knowledge points of different courses is very different (Cogan and
Gratchev 2019). For example, formulas and sample questions need to be clearly taught in the field of administration, economics, accounting, financial management, and other courses to facilitate the implementation of flipped classroom. Management, marketing, and other courses need to effectively cultivate students’ thinking ability through frequent interaction between teachers and students (Dapples et al. 2002).

Possible problems of students

One is the challenge of students’ self-learning ability. This requires that students must have a high sense of self-management learning, so that they can more reasonably arrange their own learning time and learn, think, and ask questions in advance through teaching videos, so as to ensure the quality of “first-time learning” before class, so that they can have a more effective inquiry and communication with teachers in class, to solve their own problems before class, but also convenient to communicate with the students (Fell et al. 2008). The second is the enthusiasm of students. Flipped classroom mode requires students to do a lot of extracurricular learning, which needs corresponding systems and methods to improve students’ learning enthusiasm. Third, classroom monitoring is prone to loopholes. Because we use technology like rain classroom to use mobile phones in flipped classroom, the flashing messages of many social software not only distract students but also students with poor self-control ability. This is an excuse to play openly on mobile phones, which makes it more difficult to monitor in the classroom.

Cost-effectiveness of teaching reform

One is the input cost. The implementation of educational models such as flipped classroom, the effective use of educational tools such as rain room classroom, and the establishment of standardized intelligent classroom have high requirements for software and hardware equipment and network conditions. These support provisions need a lot of manpower, financial resources, and materials to build. Due to the high cost of maintenance and investment, it is necessary for private universities to fully prove the relationship between capital investment and the results of education reform, avoid repeated construction and implement relevant education reform in stages. The second is productivity (Guzzetti et al. 2005). The “productivity” of education reform are not as direct as short-term economic benefits and are not easy to measure. The most direct benefit of education reform is not only students’ academic performance but also the change of students’ learning conditions and the improvement of various abilities, which is a long-term process. Consider the method of measuring the effect of education, regard the education reform as a long-term process, build up confidence, continue to explore, improve, and upgrade.

Strategies for innovation of new teaching mode in colleges and universities

Overall design

Changing the current traditional teaching methods and improving the quality of classroom teaching have always been the goal of the current education reform. So in order to achieve this goal, the first thing to do is to sort out the plan and system design scheme for the school and some relevant education departments. Choosing a certain specialty, a certain course, or a certain teacher to carry out experiments, with a relatively small coverage can find the best choice between the new education mode and disciplines, courses, knowledge points, etc. Taking flipped classroom as an example, the overall design needs to consider several key aspects. One is the course arrangement, which needs to ensure that not many courses are held on the same day. Even if the course is the same as the flipped classroom, every class cannot be set as the flipped classroom. According to the nature of teaching tasks and content, it should be matched with other types of courses (Harilal et al. 2019). The second is the arrangement of teachers. Teachers will meet the requirements of teaching ability, teaching level, and professional level should first lead the flipped classroom experiment. The third is the total study time of students. According to the law of college students’ physical and mental development, this paper reasonably calculates the best time to concentrate on doing homework after class and adjusts the students’ learning burden to ensure the learning effect. Fourthly, we should consider changing the evaluation content and method and provide policy and institutional support (Hemasinghe et al. 2018).

Strengthen applicability analysis

We need to focus on which education model or course is suitable for each subject or course and how to combine these education models to produce the effect of “1 + 1 > 2”. The application of a specific new education model requires enhanced applicability analysis in the aspects of subject attributes, curriculum characteristics, education objectives, knowledge points, and the status of teachers and students. Private universities continue to study the academic situation, considering the reality that students’ general self-management skills and self-learning awareness are insufficient, combining traditional education with new models such as flipped classroom and providing educational tools (Kanungo and Sharma 2014). Rain classroom is an important tool to supplement and study before and after class, investigate, and analyze students’ interest points, gradually improve their autonomous learning ability, and effectively improve their educational effect.
Strengthen teacher training

First, each education department sends teachers to participate in specialized training on new education models and new technologies, such as flipped classroom and online open courses, and trains other teachers after returning home. Secondly, the school organizes relevant training uniformly, which can be comprehensive or partially strengthened (Kritikos and Davies 2015), for example, information technology and information literacy training, micro video design and production training, classroom education organization and classroom activity design training, teaching methods and education concept training, and so on (Kaur et al. 2018). More importantly, teachers need to strengthen self-training and pay attention to updating their knowledge and skills.

Access to quality teaching resources

Educational resources can be created by teachers themselves or obtained through open educational resources. Some demonstration micro videos can be designed by teachers, but for a series of micro videos suitable for a certain course or semester, some education departments will purchase them with sufficient funds for professional construction or other projects and can do so or hand them over to professional companies. After professional training for design and production or collaborative development. For education departments with insufficient funds, teachers can form teams and divide their work according to their professional knowledge. Everyone is responsible for the design, material collection, PPT production, video production, lectures, and online Q&A. The team leader will conduct performance evaluation (Kayastha et al. 2013). We also cooperate with various education departments and teachers in the fields of computer and digital media to develop educational resources for special courses, such as humanities and social sciences, language expression, information technology, and art, which can fully integrate design, etc.

Conclusion

The research based on wireless sensor network has become one of the new frontier hot spots that attract international attention. Considering the limited energy characteristics of infrared sensor networks, most of the energy consumption of sensor nodes is consumed by network communication. The process of network communication is closely related to the content of network protocol. Through the common terms such as micro curriculum, MOOC, flipped classroom, and wisdom, such as classroom and intelligent classroom, we can clearly see the changes of education concepts and models brought about by the education reform: the classroom knowledge teaching model with the teacher as the center, textbook as the center, and classroom as the center is gradually replaced by the student as the center and problem as the center. This change is the essence and core of intelligent education. In some laboratories and nontraditional classrooms, universal wheels can be installed under chairs to facilitate pulling, so as to form different types of groups according to educational needs. The design of desks and chairs will be more humanized, so that students can freely carry out activities and discussions in the classroom. By setting up a LAN and adding a large screen, we cannot only focus on feedback but also monitor the learning status in real time more easily.

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Declarations

Conflict of interest The authors declare no competing interests.

References

Althuwaynee OF, Pradhan B, Park H-J, Lee JH (2014) A novel ensemble decision tree-based chi-squared automatic interaction detection (chaid) and multivariate logistic regression models in landslide susceptibility mapping. Landslides 11(6):1063–1078. https://doi.org/10.1007/s10346-014-0466-0

Arora MK, Das Gupta AS, Gupta RP (2004) An artificial neural network approach for landslide hazard zonation in the Bhagirathi (Ganga) Valley, Himalayas. Int J Remote Sens 25(3):559–572. https://doi.org/10.1080/0143116031000156819

Baeeza C, Corominas J (2001) Assessment of shallow landslide susceptibility by means of multivariate statistical techniques. Earth Surf Process Landf 26(12):1251–1263. https://doi.org/10.1002/esp.263

Chae BG, Park HJ, Catani F, Simoni A, Berti M (2017) Landslide prediction, monitoring and early warning: a concise review of state-of-the-art. Geosci J 21(6):1033–1070. https://doi.org/10.1007/s12303-017-0034-4

Chang K-T, Chiang S-H (2009) An integrated model for predicting rainfall-induced landslides. Geomorphology 105(3–4):366–373. https://doi.org/10.1016/j.geomorph.2008.10.012

Chau KT, Y. F. T (2004) GIS based rockfall hazard map for Hong Kong. Int J Rock Mech Min Sci 41(3):1–6

Cogar J, Gratchev I (2019) A study on the effect of rainfall and slope characteristics on landslide initiation by means of flume tests. Landslides 16(12):2369–2379. https://doi.org/10.1007/s10346-019-01261-0

Dapples F, Lotter AF, Van Leeuwen JFN, Van Der Knaap WO, Dimitriadis S, Oswald D (2002) Paleolimnological evidence for increased landslide activity due to forest clearing and land-use since 3600 cal bp in the western swiss alps. J Paleolimnol 27(2):239–248. https://doi.org/10.1023/A:1014215501407

Fell R, Corominas J, Bonnard C, Cascini L, Lerici E, Savage WZ (2008) Guidelines for landslide susceptibility, hazard and risk zoning for...
