

Analysis of the learning evaluation of distance education based on the Internet of Things

Ya-fu Bao

Changchun Vocational Institute of Technology
Changchun, People's Republic of China

ABSTRACT: Distance education has become one of the most important modes of learning. According to the overview of the Internet of Things and the existing problems of learning evaluation of distance education, the functions, advantages and improvements possible using the Internet of Things in learning evaluation of distance education are summarised. The general application of the Internet of Things in learning evaluation should provide improvement and benefit the stakeholders.

INTRODUCTION

The development of computer and network technology has increased the importance of distance education. The emergence of the Internet of Things has epoch-making significance for distance education. This article illustrates how the Internet of Things supports learning in distance education. Pressing questions for distance education managers are how to provide immediate, accurate, efficient and convenient evaluations to students; how to tailor the academic environment to the students' needs; and how to establish a fair and balanced distance education system. The technology of the Internet of Things can help establish a new distance education environment with equity by effectively sensing a learners' situation.

THE OVERVIEW OF THE INTERNET OF THINGS

The Connotation of the Internet of Things

The official concept of The Internet of Things was first proposed by the UN specialised agency, the International Telecommunication Union (ITU) in The Internet Report of ITU: The Internet of Things, 17 November 2005. The Internet of Things involves the connection of thing to thing (T2T), human to thing (H2T) and human to human (H2H) [1]. It includes connecting information-sensing equipment, such as RFIDs (radio frequency ID), infrared sensors, GPS and laser scanners to exchange information and communicate via the Internet. This can realise intelligent identification, positioning, tracking, monitoring and management of information. The Internet of Things can be used for general and technical connection of thing to thing, thing to computer and computer to computer.

Features of the Internet of Things

- Connection:

Connection is the essence of The Internet of Things. There are three aspects of connection in The Internet of Things, viz. *any time* connection, *any place* connection and *anything* connection [2].

- Technology:

The Internet of Things must be supported by powerful technologies, including central processing, cloud computing, micro-machining processing technology and software, wireless sensor networks (WSN), RFID, sensors and intelligent embedded systems [3].

- Intelligence:

The Internet of Things needs to connect many things. It may not only need to sense things, but also sense the environment or even the subtle emotional changes of people. This requires intelligence and processing power [4].

The Network Structure of the Internet of Things

The network structure can be divided into three layers, viz. the sensing layer, network layer and application layer [5]. The sensing layer, responsible for collecting information, is the key technology of the Internet of Things and includes RFID technology used for small, low-consumption, low-cost label identification; sensor technology used for T2T and T2H in the Internet of Things; positioning technology used to locate; and laser identification technology. The network layer is the infrastructure when the Internet of Things is interconnected. This includes, for example, LANs (local area networks), MANs (metropolitan area networks), and WANs (wide area networks). The application layer involves business applications of the government, industries and the public. Distance education belongs to the last of these.

LEARNING EVALUATION OF DISTANCE EDUCATION

Current Situation of Learning Evaluation of Distance Education

Distance education includes self-learning of paper materials, on-line teaching, face-to-face teaching, answering questions, on-line quizzes, on-line discussion, on-line experiments, essays, case studies, group discussion, examinations, and the graduation thesis [6-9]. At present, examinations are widely used to evaluate distance learners because of the large number of learners. Few distance learning institutes combine a number of indices to produce an evaluation. But, it is most complicated to collect student information and is prone to inaccuracy.

The academic performance of most distance learners is determined by on-line quizzes and examinations, which is an inadequate method. Processing and summative evaluations should be unified. Many learners exploit the difficulty of teachers having face-to-face contact with students, and create the illusion of learning by just staying on-line. Evaluating the distance learners by final examinations not only damages other learners, but also has a negative influence on the learning climate in distance education. This is an important reason for the poor reputation of distance education [10].

Improving the Evaluation of Distance Education

The evaluation of learners, especially distance learners, should be determined by performance data covering various aspects of learning. This is required if distance education is to maintain its vitality and also promote the development of the required educational technology. In this way, there can be an accurate and objective evaluation of learners in distance education. However, distance education is different from traditional education. It is difficult for teachers to have face-to-face contact with students or to know how serious the students are or how much time they spend learning. There are also additional difficulties in evaluating distance education.

According to ecology, a network system should actively extract information from the outside environment, convert it into knowledge and maintain a virtuous circle in the system, to reach a dynamic balance of matter and energy with the outside world [11]. By analogy, the Internet of Things can solve problems in distance education systems by extracting people's information into the network and dealing with information automatically.

THE INTERNET OF THINGS AND LEARNING EVALUATION OF DISTANCE EDUCATION

Information Acquisition in the Evaluation of Distance Education

The Internet of Things could input learners' information about learning activities through input equipment. This could establish a student file for distance learners to record all learning activities from entering school to graduation. The Internet of Things could evaluate a learner's situation through personal characteristics, such as blink frequency, respiration or body sway.

Smilek opined ...*According to experiments, when people are not concentrated, they will unconsciously close their eyes to reduce information to enter into brain.* When learners are not concentrated (wholly directed to one thing), their blinking frequency will lower to 10 to 20 times per minute or even three to five times in one minute [12].

Figure 1 demonstrates the relationship between respiration and different personal condition, e.g. after sport, concentrating [12].

It can be seen that the respiration can be six to eight times more after exercise than normal, returning to normal several minutes later. When concentrated, the respiratory times will be less with greater respiratory depth. Such information can be recorded by computers using digital ink technology [13]. A tablet digital ink technology can quickly convert the words and pictures into a digital format.

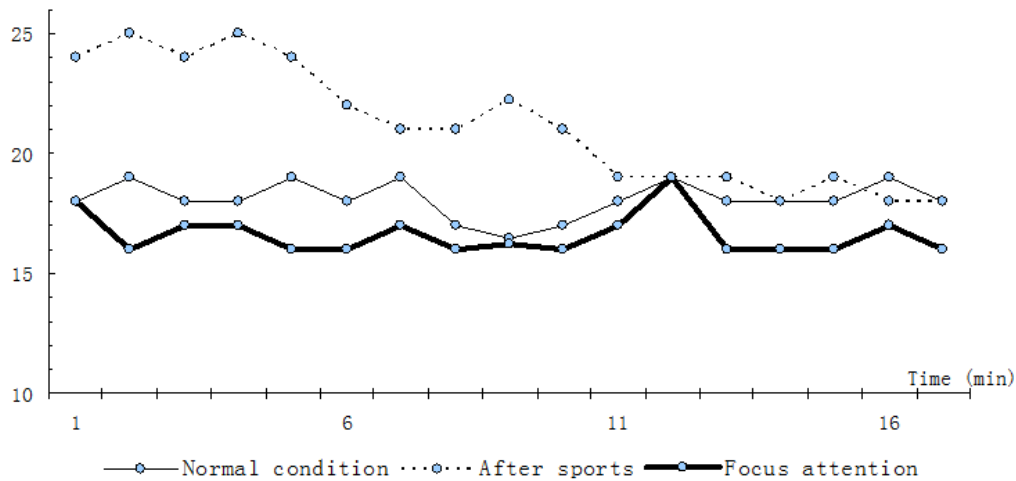


Figure 1: Respiratory times for learners in different conditions.

Availability of Evaluation Information of Distance Education

The Internet of Things can be used to establish a public platform for learning evaluation of distance education on which the learning evaluation of distance learners and evaluation criteria are available. Learners can know his or her own learning situation, as well as others' through the platform to encourage learning. Here, the Internet of Things can play the role of stimulating communication and mutual learning between learners; thereby, enhancing the credibility of distance education.

A Virtual Learning Community

A virtual learning community using the Internet of Things could provide learning information immediately and intelligently as part of the learning environment. The evaluation of distance education not only relies on the in-class performance of learners, but also depends on the learning situation in their spare time. The evaluation of their spare-time learning can be conducted on the basis of the virtual learning community. People communicate through the Internet and form virtual communities, which is the accumulation and cohesion of interpersonal relationships and shared experiences [14]. In the virtual community, learners can have free speech, raise and answer questions, as well as upload and download materials. The server will record community members' learning activities and, then, the computer will deal with this information using social analysis software, such as UCINET. This will produce information, such as who is the *opinion leader* and who is marginalised, in order to determine the learning situation of distance learners.

Automatic Evaluation of Distance Education

The Internet of Things can be used to evaluate the collected information of distance education. The learning terminal devices connect with servers, databases and the personal computers of teachers at distance education institutions. The learning terminal devices include desktops, notebooks, 3G mobile phones, STB (set top box) and digital television. The program developer must design evaluation software in accordance with the evaluation index system, based on the acquired information about distance education. The learning terminal and server are a client-server system, with the evaluation software in the learning terminal rather than the server. If the image information of students is dealt with by the server, the load on the server would be high because of the large numbers of learners. But, if the evaluation software is installed on the learning terminal, the automatic evaluation of distance education would be realised by simply transferring personal processed data to the database at the institutions.

ADVANTAGES OF THE INTERNET OF THINGS IN THE EVALUATION OF DISTANCE EDUCATION

The features of the Internet of the Things and distance education imply that the large-scale application of the Internet of Things in distance education is inevitable. The Internet of Things enjoys its unique advantage in distance education because students and teachers cannot communicate face-to-face and, hence, will lead to an evolutionary development of distance education [15]. This influence has the following aspects:

- Improving the learning motivation of distance learners:

Some distance learners are just diploma-oriented, and waste a lot of their time. They take advantage of the fact that students and teachers cannot have face-to-face communication, to idle away their time staying on-line and become undisciplined. Introducing the Internet of Things to distance education will help to identify the half-hearted and correct learners' attitude to learning.

- Individualised teaching:

Teachers were the main subjects of the previous distance education mode. They teach based on their own experience and are not able to judge properly a learner's situation to ensure the teaching effect. After introducing the Internet of Things, teachers can judge a learner's situation through data collected and accordingly adjust the teaching progress or methods.

- More efficient and better quality evaluation of distance education:

At present, distance education is manually evaluated and so requires a huge workforce. This does not work well, especially, for those distance education institutions who evaluate learners using various indices. Employing the Internet of Things to evaluate distance education can decrease significantly the labour required, because the computer can collect and process the learning information automatically. Also, teachers get accurate feedback from the evaluation.

- A fair and balanced environment for distance education:

It often happens in distance education that the learning evaluation is not proportional to a learner's effort. Apart from learners' personal reasons, an important reason is the contingency of examinations. Such tends to influence learners' confidence and exert a negative influence on the environment of distance education.

This effect could be mitigated by introducing the Internet of Things. By combining many indices, the computer automatically provides learning evaluation tailored to the learner's situation. In this way, learners have a fair and balanced environment in distance education and can be stimulated to learn in a more active way. A healthy learning climate of distance education requires learners to have the right attitude.

- Approval of distance education:

Investigation shows that the approval of certificates obtained by different learning methods can be listed from high to low, thus: certificates of unified recruitment, self-taught education, adult education and distance education. The poor reputation of distance education mainly results from distance learners' poor supervision, so their learning quality cannot be guaranteed. If the distance education institutions want to change this awkward situation, they must supervise learners in an effective way and reform the evaluation of distance education. Supervision, an important feature of the Internet, can be applied in every aspect of distance education, to change people's stereotypical view of distance education.

CURRENT PROBLEMS AND MEASURES TO COUNTER

Teachers' Lack of Awareness of Internet of Things Teaching

Many teachers lack an awareness of the Internet of Things teaching and have only a superficial understanding of the technology of the Internet of Things [16]. This arises because the Internet of Things is an emerging technology. Some teachers resist the technology, because they fear it is a challenge. They are accustomed to traditional teaching and have a negative view of new methods. Therefore, teachers, especially teachers of distance education, should be required to further their learning of the Internet of Things. Only by strengthening understanding of the Internet of Things can the new technology be put into practice.

Inadequate Investment in the Internet of Things in Distance Education

The Internet of Things, which can be applied to all walks of life, engenders great enthusiasm, especially in various industries, including the games industry. However, there is little or no study of its application in distance education and in the evaluation of distance education. More investment should be put into the study of the application of the Internet of Things in distance education and, hence, promote an effective role for the Internet of Things in distance education.

High Price of the Equipment

The hand-writing tablets based on the technology of digital ink and sensors are expensive, which hinders the use of the Internet of Things in distance education. The shortage of special equipment for developing applications of the Internet of Things in distance education requires more attention and investment from companies.

There are three stages in the industrial development of the Internet of Things; namely, key applications, massive applications and general applications [17]. At present, China is still in the key applications stage and exploration by leading companies has only covered key applications in industry, agriculture and society. There is a long way to go in China before the stage of massive applications and general applications of the Internet of Things in China.

CONCLUSIONS

Although it is difficult to popularise the Internet of Things for learning evaluation in distance education, it is a significant trend driven by features of the Internet of Things and the requirements of distance education. The future development of distance education is closely related to the Internet of Things. The general application of the Internet of Things in the learning evaluation of distance education will greatly influence further development of distance education.

REFERENCES

1. Ahuja, S., Johari, R. and Khokhar, C., IoTA: Internet of things application. *Advances in Intelligent Systems and Computing*, 381, 235-247 (2016).
2. Dressler, F. and Fischer, S., Connecting in-body nano communication with body area networks: challenges and opportunities of the Internet of Nano Things. *Nano Commun. Networks*, 6, 2, 29-38 (2015).
3. Serdaroglu, K.C. and Baydere, S., WiSEGATE: wireless sensor network gateway framework for Internet of Things. *Wireless Networks*, 18, 1-17 (2015).
4. Sehgal, V.K., Patrick, A. and Soni, A.R., Smart human security framework using Internet of Things, cloud and fog computing. *Advances in Intelligent Systems and Computing*, 321, 251-263 (2015).
5. Guo J. and Guo, C., The construction strategy of the Internet of Things industry development. *Digital Communic. World*, 7, 13-16 (2010).
6. Li, H., A Web-based virtual laboratory for distance education. *World Trans. on Engng. and Technol. Educ.*, 13, 4, 544-549 (2015).
7. Chen, M., SWOT analysis and strategies to support college physical education through distance education. *World Trans. on Engng. and Technol. Educ.*, 12, 4, 671-674 (2014).
8. Yao, J., Multilayer model for on-line learning resources based on cognitive load theory. *World Trans. on Engng. and Technol. Educ.*, 13, 3, 245-250 (2015).
9. Tao, K. and Shanhong, Z., The distance teaching model of information and technology based on CSCL. *World Trans. on Engng. and Technol. Educ.*, 12, 2, 251-255 (2014).
10. Li, D., Xu, X., Li, Y-s. and Wang, Y., Designing a developmental evaluation system for a network teaching platform. *World Trans. on Engng. and Technol. Educ.*, 13, 4, 456-461 (2015).
11. Li, C. and Zhang, H., Study on the balance mechanism of network learning ecosystem. *J. of Henan Normal University*, 2, 244-247 (2009).
12. Smilek, D., Sinnett, S., Kingstone, A. and Ensley, C., *Cognition + Discovery Labs*. (5th Edn), Oxford: Oxford University Press, 320-345 (2013).
13. Liu, Y., A new human computer interaction technology in digital ink. *CHIP*, 9, 176-178 (2004).
14. Li, M., Zhang, L. and Liu, M. The accounting teaching method based on the characteristics of college students' thinking. *The Friend of Accounting*, 8, 82-84 (2009).
15. Zhang, H.F. and Yang, X.H., The research of technologies evaluating Web-based learning based on The Internet of Things. *Modern Educational Technol.*, 21, 5, 91-94 (2011).
16. Wang, Y., Research on English interactive teaching mode based on Internet of Things. *Distance Educ.*, 6, 53-55 (2010).
17. Li, X., Europe, the United States, Japan and South Korea and China's Internet of Things development strategy - the global development of the Internet of Things. *Expert Forum*, 3, 49-53 (2010).